Expanding Scenarios for Visible Learners

Innovative Designs of Including Technology-based Interventions for Learners with Developmental and Attention Difficulties in K1-K10 Practices

Andersen, Hanne Voldborg

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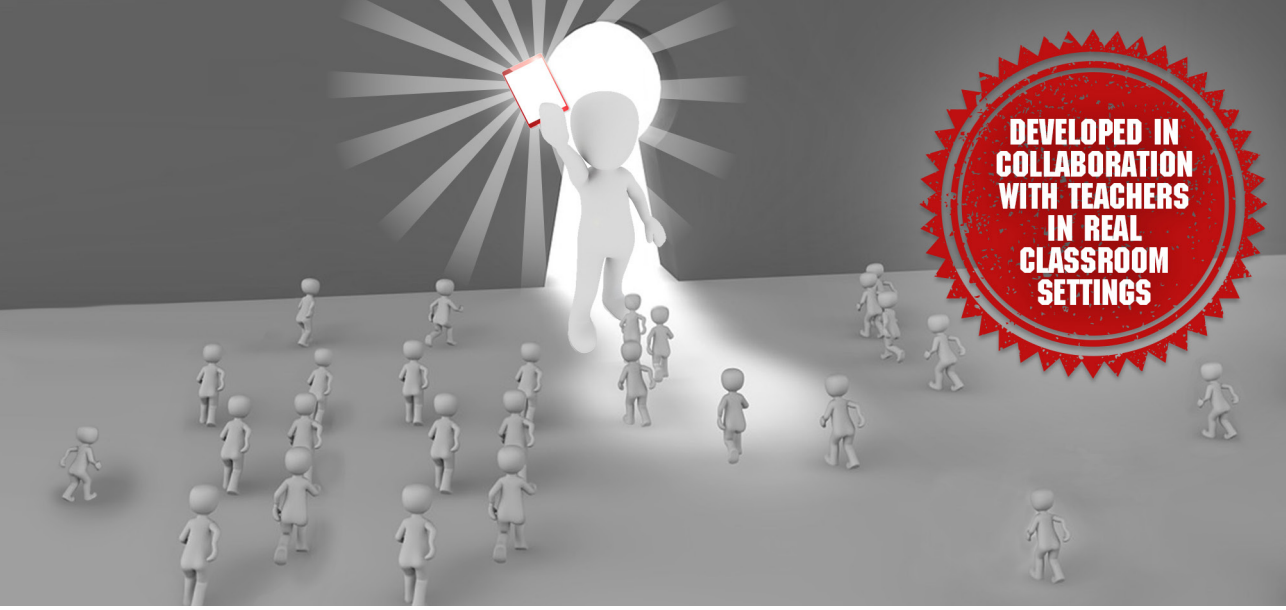

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BY
HANNE VOLDBORG ANDERSEN

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AALBORG UNIVERSITY
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Hanne Voldborg Andersen

AALBORG UNIVERSITY
DENMARK

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PhD supervisor: Professor Elsebeth Korsgaard Sorensen
Aalborg University, Denmark

PhD committee: Professor wsr Eva Brooks (chair.)
Aalborg University

Professor Emeritus Alan Tait
The Open University

Professor Knut Steinar Engelsen
Høgskulen på Vestlandet

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AUTHOR CV

I have been dedicated to deploy technology as an enzym for learning since I graduated from teacher education in 1993. I survived the first big paradigm shift when WordPerfect for Windows eliminated the DOS version and wrote my own learning materials because of necessity and exitement. Since then, I have welcomed laserprinters, labtops, the Internet, WIFI, Smartboards, mobile phones, iPads, Web 2.0 applications, Facebook, blogs, skype, robotics and a stream of digital gadget and applications in my repertoire as a teacher. Delighted and enthusiastic, I have spent most of my time learning how to manage emerging technologies and persuade colleagues to follow suit. Next to my teaching, as ICT consultant, I have arranged workshops and conferences, made presentations, supported teachers, schools, and municipalities in implementation of technologies, and reflected my experiences in articles on technology and learning.

A master programme in ICT and Learning (MIL) 2009-2011 was an eye opener for the complexity of teaching and learning, and brought forward a new network of like-minded colleagues and friends. It inspired me to enter the field of empowerment of learners with special needs through technologies. The master thesis constituted the inspiration for the ididakt research project, which was running 2013-2016 focussing on the affordances of technology for supporting learners with developmental and attention difficulties. This Ph.D thesis revisits parts from this research, links together insights, and completes my work into this study.

From my current position, working for empowerment of learners into the field of Digital Fabrication and Design Thinking, I am still curious on investigating possibilities for taking advantage of new technologies. Though, today I am even more aware of the necessity for ensuring all citizens equal access, deep knowledge and adequate comptencies to utilise digital technologies to enhance learning, empower people, and improve the world.

Hanne Voldborg Andersen, January 2018

ENGLISH SUMMARY

As a consequence of a political request in 2012 for establishment of an inclusive educational system, Danish elementary schools have experienced an increasing demand for including learners with special educational needs in mainstream classes. Headmasters and teachers express a lack of knowledge, competencies and resources for solving this task - especially regarding learners with developmental and attention difficulties.

'Children with developmental and attention difficulties' is an imprecise umbrella term for an inhomogeneous group of children, who due to varying causes and at different levels are challenged in life and learning. The delimitation could be formed by the diagnoses Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD). However, developmental or attention difficulties may also appear without these diagnoses. The diagnoses ADHD and ASD include many variations of challenges or associated comorbid disorders, which often hinder a clear delimitation and draw a very complex picture of the issues. Caused to the wide spectrum of challenges, it can be difficult to choose a fixed solution for these children.

Simultaneously, a rapid development of digital technologies and a widespread digitalisation of the public sector have resulted in an increased access to hardware and software in educational settings. Since the amount of emerging technologies are enormous and the development seems infinite, teachers' and learners' access to technologies are increasing. Generally, the field is marked by a great deal of hype and marketing rhetoric for 'brand new products and emerging possibilities' and unfortunately less focus on the real practical use. Thus, it might be difficult for teachers to attain knowledge about and choose among the countless technological options, why support and knowledge are requested.

Astonishingly, in spite of the amount of research on technology and learning or special education and learning, there is only little research on teachers' use of technologies for inclusion purposes of this target group in basic classroom settings. Thus, inspired by a high expectation to the impact of technology in the enhanced digitalisation of the public sector and a request for enhanced inclusion of learners with special needs in the basic school system, this thesis investigates how teachers can be supported in developing innovative, pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties.

The article-based Ph.D. thesis consists of seven research papers, which are gathered in the separate publication *Expanding Scenarios for Visible Learners – the research*

behind. The dissertation framework falls into two parts. The first part contains the theoretical and methodological basis behind the accomplished research, while then second part presents and reflects the articles on which the thesis rests. While the dissertation articles take their point of departure in technologies and focus learners' needs, the thesis framework reflects the same work, only from the perspective of teachers. The framework may be understood as meta perspective study, where the dissertation papers are revisited, reflected, and discussed from the perspective of today.

The overall methodology in the thesis is inspired by Paul Ricoeur's thinking and the perspectives of hermeneutical phenomenology. The investigation attempts to capture the 'truth of life' as it occurs in the general classroom through learners' and teachers' experiences and researcher's observations and interpretations of events and phenomena. The context of empirical investigations is established using an Educational Design Research (EDR) approach, where iterative development of solutions to practical and complex inclusion challenges is conducted in Participatory Action Research (PAR) processes at 11 schools in three municipalities. 46 teachers have been involved as co-researchers. Researchers have studied the movements, but also initiated actions based on theoretical knowledge and understandings about inclusion, learning, and technology in order to generate learning in the field.

On the basis of one year of research at five schools, where teachers and researchers have worked together and collaboratively investigated the including potential of technologies in the basic classroom setting, the study identifies five categories of technologies valuable for supporting the focus learners in the classroom:

1. Structure & Overview
2. Shielding & Focus
3. Differentiation & Comprehension
4. Production & Communication
5. Dialogue & Collaboration

Technologies can be used as a shielding tool to increase learners' focus and support inclusion at a physical level. Technologies used as a structuring tool can provide learners an overview, which can be useful both for their participation at a physical and academical level. Various kinds of technologies and digital modalities may increase the differentiation and support the comprehension at an academical level, while technologies for production can support both the expression and the communication, and with it both academical and social inclusion. Finally, technologies can be used as a tool for dialogue and collaboration and in that sense support inclusion at a social level. Following research at six new schools supports these findings as documented in the dissertation articles.

While these research articles primarily address teachers and provide them with inspiration for what they may do to support learners with developmental and attention difficulties, a meta reflection on the dissertation articles to a greater extent applies gatekeepers around teachers as e.g. principals, supervisors, consultants, public servants, or politicians and supply them with a framework on how teachers may be supported in their teaching practice to develop and utilise the beneficial findings from the study. This reflecting framework suggests awareness on the development processes during seven important steps:

1. Clarify the knowledge available in e.g. a learning team and 'make the knowledge visible'
2. Acknowledge the dilemmas in the inclusion processes and 'make the complexity visible'
3. Understand individual learners' specific special needs and 'make the learners visible'
4. Elucidate achievable support from experts and 'make the support visible'
5. Decide collaboratively why, how and what to do in the classroom and 'make the pedagogy visible'
6. Develop collaborative awareness on the purposes for and impact of applied technologies and 'make the technological purpose visible'
7. Consider the impact of interventions in a longer perspective and 'make the overall goal visible'

In general, this dissertation provides an understanding of why and how visible learners – either pupils with developmental and attention difficulties or teachers in an including practice - may be supported when implementing technology-based including interventions in the basic classroom. From a context of a nature, in which an including technology-based approach may be implemented, the study identifies some challenges and conflicting interest.

- Are we handling visible disabilities different than invisible disabilities?
- Are we focussing on technology rather than practice?
- Do we consider differences from teaching 1:1 versus teaching 1:28?
- Are we praising standardisation or diversity?
- Are the challenges of inclusion considered as an individual or collaborative task?
- Are teachers uneducated or skilled?
- Are the interventions supporting adjustment or development of the learners?

.

DANSK RESUME

Som konsekvens af et politisk ønske om et inkluderende uddannelsessystem har der siden 2012 været en stigende forventning til danske skoler om at kunne inkludere elever med særlige behov i folkeskolens almindelige klasser. Skoleledere og lærere har givet udtryk for mangel på viden, kompetencer og ressourcer for at løfte den opgave – særligt i forhold til elever med udviklings- og opmærksomhedsproblemer.

'Elever med udviklings- og opmærksomhedsproblemer' er en uprækcis fællesbetegnelse for en uhomogen gruppe af elever, som af forskellige årsager og på forskellig måde er udfordret i liv og læring. Gruppen kunne beskrives som elever med Attention Deficit Hyperactivity Disorder (ADHD) eller Autisme Spektrum Forstyrrelser (ASF), men udviklings- og opmærksomhedsproblemer kan også forekomme uden disse diagnoser. ADHD og ASF inkluderer mange variationer af udfordringer eller tilhørende komorbide forstyrrelser, som hindrer en klar afgrænsning og tegner et meget komplekst billede af problemstillingerne. På grund af det meget brede spektrum af udfordringer er det svært at angive en fast opskrift for at støtte disse elever.

Samtidig har den hastige teknologiske udvikling og en omfattende digitalisering af den offentlige sektor medført øget adgang til både hardware og software bredt set i uddannelsessystemet. Eftersom mængden af nye teknologier er stor og udviklingen synes uendelig, vil lærere og elevers adgang til teknologier vedvarende øges.

Det digitale felt er generelt præget af stor optimisme og marketingsmæssig retorik for 'splinternye produkter med fantastiske potentialer', mens der kun i mindre grad er fokus på hvordan teknologierne virker i den pædagogiske praksis. Det kan være svært for almindelige lærere at overskue og vælge mellem de utallige teknologiske muligheder, hvorfor der synes behov for vejledning og viden på området.

Set i lyset af den store mængde forskning inden for teknologi og læring eller specialundervisning og læring, er forekomsten af forskning i læreres brug af teknologier med inkluderende formål for denne målgruppe i almenundervisningen overraskende lille. Denne afhandling vil derfor tage afsæt I de store forventninger til teknologiens potentiale, den øgede digitalisering og ønsket om øget inklusion af elever med særlige behov, for at undersøge:

Hvordan kan lærere støttes til at udvikle innovative pædagogiske undervisningsdesign, der ved hjælp af inkluderende teknologibaserede interventioner fremmer inklusion af elever med udviklings- og opmærksomhedsproblemer?

I afhandlingen indgår syv selvstændige artikler, som er samlet i en selvstændig udgivelse *Expanding Scenarios for Visible Learners – the research behind.* Rammeværket kan forstås som et metaperspektiv studie, hvor disse artikler er genbesøgt, reflekteret og diskuteret fra et nutidigt perspektiv. Rammeværket består af to dele. Første del indeholder det teoretiske og metodologiske grundlag for den gennemførte forskning. Anden del præsenterer de syv selvstændige artikler og samler konklusionerne herfra til en model for, hvordan teknologier kan anvendes til at fremme inklusion af målgruppen.

Afhandlingens overordnede metodologi er inspireret af Paul Ricoeurs tænkning og den hermeneutiske fænomenologi. Undersøgelsen forsøger at indfange 'det levede liv', som det forekommer i det almindelige klasseværelse gennem elevers og læreres oplevelser og forskernes observationer og fortolkninger af hændelser og fænomener. De empiriske undersøgelser udføres som Educational Design Research (EDR), der som forskningsmetode skaber rammen for iterativ udvikling af løsninger på praktiske og komplekser inklusionsudfordringer i aktionsforskningsprocesser på 11 skoler i tre kommuner med 46 lærere som med-forskere. Forskerne har initieret aktioner i 26 klasser med udgangspunkt i forskningsbaseret viden om inklusion, læring og teknologi, og har løbende indsamlet data fra mangeartede teknologi-baserede pædagogiske interventioner rettet mod alle elever, men med særlig fokus på 56 elever med udviklings- og opmærksomhedsproblemer.

Efter et års interventioner på fem skoler, hvor lærere og forskere i fællesskab har udforsket det inkluderende potentiale i en række teknologier i almenundervisningen, identificeres fem kategorier af teknologier som værende særligt værdifulde i forhold til inklusion af denne målgruppe:

1. Struktur og overblik
2. Skærmning og fokus
3. Differentiering og forståelse
4. Produktion og formidling
5. Dialog og samarbejde

Teknologier kan bruges som strukturerende redskaber, der tilbyder eleverne et overblik, som kan støtte deres fysiske deltagelse og faglige bidrag i undervisningen. Andre teknologier kan anvendes som skærmende redskaber, der kan støtte elevers faglige fokus og fysiske tilstedeværelse i klassen. De digitale teknologier tilbyder mange forskellige modaliteter, som kan gøre det nemmere at differentiere det faglige indhold til forskellige elevers forståelsesmæssige behov, men de mange modaliteter giver omvendt også eleverne flere udtryksformer at vælge imellem. Det kan øge deres mulighed for at formidle faglig viden til andre og dermed understøtte elevernes fagligt og socialt. Endelig kan teknologier anvendes som redskab for dialog og samarbejde og i den forståelse ligeledes bidrage til social og faglig inklusion.

Yderligere forskning på seks andre skoler understøttede disse resultater, hvilket fremgår af afhandlingens artikler.

Mens afhandlingens artikler primært beskriver, hvordan lærere og pædagogisk personale kan anvende teknologi-baserede interventioner til at støtte inklusion af elever med udviklings- og opmærksomhedsproblemer, beskriver afhandlingens rammeværk i højere grad hvordan beslutningstagere rundt om lærerne, som fx skoleledere, vejledere, konsulenter, embedsfolk eller politikere vil kunne støtte lærere til at udvikle og udnytte de positive resultater fra dette studie i egen undervisningspraksis. Rammeværkets konklusioner kan sammenfattes i syv anbefalinger:

1. Gør viden synlig – dvs. afdæk den tilgængelige viden i fx et lærerteam
2. Gør kompleksiteten synlig – dvs. anerkend inklusionsprocessens dilemmaer
3. Gør eleverne synlig – dvs. afdæk de individuelle elevers særlige behov
4. Gør supporten synlig – dvs. afklar den tilgængelige support fra ressourcepersoner
5. Gør pædagogikken synlig – dvs. afgør i fællesskab hvorfor, hvordan og hvad, der skal gøres
6. Gør teknologiens formål synligt – dvs. skab fælles bevidsthed om formålet med og værdien af at implementere teknologi
7. Gør det overordnede mål synligt – dvs. diskutér værdien af interventionen i et længere perspektiv

Afhandling beskriver hvorfor og hvordan 'synlige lærende', hvad enten der er tale om elever med udviklings- og opmærksomhedsproblemer eller lærere i en inkluderende praksis, kan støttes under implementering af teknologier i pædagogiske interventioner i det almindelige klasseværelse. Undersøgelsen rejser endvidere nogle spørgsmål rettet mod udfordringer og interessekonflikter, der er identificeret i det miljø, som interventionerne er udviklet i:

- Behandles synlige handicaps anderledes end usynlige?
- Fokuseres der mere på teknologien end den pædagogiske praksis?
- Anerkendes forskellen på at undervise 1 eller 28 elever?
- Hyldes standardisering frem for diversitet?
- Søges inklusionsopgaven løst individuelt eller i fællesskab?
- Forefindes de nødvendige kompetencer til at løse opgaven?
- Fokuseres der med interventionerne på at tilpasse eller udvikle eleverne?
- Tilbydes den nødvendige tid til at løse opgaven rimeligt?

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In many ways this Ph.D. study has been a long and lonely journey, but one which has provided me with so many new opportunities, challenges, insights, and colleagues. I am humbly grateful for all those encouraging and patient people, who have supported me on the way. Those, who have displayed their trust in me and provided me backing when necessary. In random order, I would like to express my deep gratitude for this immeasurable and unexpected support:

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I am indebted to my former colleagues and leaders at Søndervangskolen for their support in the initiating processes. I am also grateful to the participating leaders, teachers and learners in the ididakt project, who opened their classrooms, experiences and thoughts for my investigation. Likewise, the Ministry of Education, Aalborg University and the three municipalities for their funding and trust in our project.

Through these years a lot of good friends have lent me an ear, when I was doubtful, and encouraged me to keep on working. Deep talks late at night, when biking, walking, dining, travelling: John, Lars, Elisabeth, Anders, Eva, Henrik, Thomas… Thanks to all of you, from the bottom of my heart.

But most of all, I must express my gratitude to all of my former students, who taught me so much about teaching and learning. I wish to dedicate this Ph.D. thesis to one of them, Veronica, who was part of my mind, when this journey began. Not that it will help you now or that it can erase what happened. But the Ph.D. is written in the hope that we will learn how to create much better solutions in schools for children, who are struggling – as you did back then.

A BEGINNING, A DETOUR, AN OPEN ENDING

There's no answer as big as the question
There's no victory as big as the lesson
You go on and you see where your detours will take you to

There's no power like understanding
There's no beginning like an open ending
You hold on, you don't stop to believe

If you follow through you will learn what is good for you
Someday soon you will know what is best for you

Tina Dickow: 'An open ending'

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CHAPTER 1. INTRODUCTION

This thesis investigates how teachers can be supported in developing including technology-based practices and use technologies as a vehicle for inclusion of learners with developmental and attention difficulties (focus learners) in mainstream classroom activities.

First of all, the focus is to explore which types of technologies could be useful for teachers to implement in the classroom, when designing learning activities in classroom settings where learners with developmental and attention deficits should be included.

Secondly, how teachers could utilise these technologies in innovative pedagogical designs to enable focus learners in participating and contributing in classroom activities.

Finally, the study discusses teachers' challenges when innovative designs of including technology-based interventions for learners with developmental and attention difficulties in K1-10 teachers' practices should be evolved and how teachers should be supported in these processes.

Chapter one presents the rationale behind the thesis and the research question. Subsequently, follows a brief clarification of essential concepts before a reading guide to the full thesis is provided at the end of the chapter.

1.1. RATIONALE BEHIND THE THESIS

In 2005, as a teacher in a basic Danish primary school, I received a new pupil in my 2nd grade class without any particularly information on any special needs. Veronica was her name and she was a tiny, happy and lovely child. In my teaching team, though, we early realised that she was neither physically, socially nor academically at the same level as her peers, and for some years we were struggling to develop new pedagogical methods in order to meet her needs and support her learning processes. It was not absolutely a successful journey. We did not know much about her challenges, and when we did, we did not know how to meet them. The gap between her and the peers were growing and even if we were desperately trying to help her she was, in many ways left behind. After some years change of school became necessary, unfortunately, without any gain on her part. Later in life, she was diagnosed with Attention Deficit Disorder (ADD).

Children like Veronica with developmental and attention deficits - challenged in both life and learning due to different kinds of diagnoses or difficulties - could be found in many schools and classrooms. The prevalence of Autism Spectrum Disorder (ASD) is

upwards of 1 per cent, while the prevalence of Attention Deficit Hyperactivity Disorder (ADHD) is varying according to the diagnosis instrument used and geographic conditions (Thomsen, 2015) but said to be 4-10 % of the population (Almer & Sneum, 2009). In average, this means at least 2-3 pupils in each classroom should be expected to have difficulties related to these diagnoses.

The number of children and youngsters diagnosed with a psychiatric disorder has heavily increased during the last 15-20 years and different causes have been discussed (Brinkmann & Petersen, 2015). Is it an effect of our modern way of living, an evidence of eagerness for diagnosing, a result of change in diagnostic categories or an indication on a narrowing concept of normality in our society? (ibid.) The answer might be a combination of several interconnected explanations, but none of the reasons would in short time span be changeable for pupils like Veronika, or their teachers.

When it comes to learners with ASD or ADHD, many of them do not thrive in school (DuPaul, 2012; DuPaul & Stoner, 2014). They are not doing well and do not easily fit into the school system or the society (Barkley, 2006; Barkley, 2013). As youngsters, many of them are experiencing a lacking feeling of success or self-confidence and as adults it seems difficult for them to stay on the track in education, work or family life within the realm of the law (Dalsgaard, 2002). It should be a crucial societal task to change this negative future perspective, where teachers and schools must be considered as key stakeholders.

The role of schools and teachers are determined in both international and national legislation and initiatives carried out to ensure inclusion of persons with disabilities and special needs. United Nations 'Convention on the Rights of Persons with Disabilities' article 24 on Education determines the responsibility by all nations for

- recognising the rights of persons with disabilities to education
- provide equal opportunities, and
- ensure an inclusive education system on all levels (United Nations, 2006).

In realising this, state parties must ensure

> "persons with disabilities can access an inclusive, quality and free primary education and secondary education on an equal basis with others in the communities in which they live, […and…] receive the support required, within the general education system, to facilitate their effective education […provided as] effective individualized support measures […] in environments that maximize academic and social development, consistent with the goal of full inclusion." (ibid. p. 16-17).

At a Danish national level, the law on inclusion (Ministeriet for Børn og Undervisning, 2012a) is supposed to bring these rights into effect supported by the economic agreement with the municipality organisation 'Kommunernes Landsforening' (KL) (Regeringen og KL, 2013). The law and the agreement revise the economic model behind Special Education and specify that 96% of all learners are expected to be included in the basic school. Consequently, 10.000 learners with Special Educational Needs (SEN) must be moved from Special Education Schools to Basic Schools between 2013-2016 (Sørensen & Hein, 2014). The term '*can*' from the United Nations 'Convention on the Rights of Persons with Disabilities' article 24, is in the Danish interpretations reversed to a '*must*'.

In the case of Veronika this means, she had a right to access an inclusive education on an equal basis with others and receive the support required to maximize academic and social development (United Nations, 2006). But in reality, due to lacking competencies, her basic school teachers were not able to provide the necessary support to ensure academic and social development, and caused to the inclusion law, SEN school settings were rarely a possible alternative.

This new direction is criticised by headmasters, teachers, parents and learners, where especially challenges for learners with ASD and ADHD have a strong presence in the public and professional debates. Headmasters and teachers state, they do not have appropriate knowledge, competencies and resources to include this group of learners and call for tools to handle this new task (Danmarks Evalueringsinstitut, 2011; Danmarks Evalueringsinstitut, 2013; Arbejdsmedicinsk klinik, 2016), while parents articulate their experiences and their growing concern, when the children's special educational needs is not accommodated (Jessen, 2015).

While the quantitative and emotional demands in the inclusion processes give rise to increased stress among teachers (Arbejdsmedicinsk klinik, 2016) hundreds of children are affected in such a degree they do no show up in school (Videbæk & Jørgensen, 2017). Parents are moving their children to private primary schools or independent boarding school for lower secondary pupils (Nepper-Rasmussen, 2016).

> "You cannot use another word than catastrophe on this situation. We have no right to do so. We should be known as those who provided the very best education to those with extensive needs. For the moment, we do not live up to that." (Head of Teachers' Union, Anders Bondo Christensen in ibid., my translation).

It is evident, there seems to be a lack of coherence between the political expectations and the practical conditions. Likewise, it is evident, there seems to be a lack of research and knowledge in how to facilitate the inclusion processes (Ratner, 2012). The Ministry of Education calls broadly for knowledge on 'what works' (Dyssegaard, Søgaard Larsen, & Dansk Clearinghouse for Uddannelsesforskning,

2013) and establishes the Resource Centre for Inclusion and Special Education in 2012 (Ministeriet for børn og undervisning, 2012) with the aim of creating an overview on the research in this field, developing new knowledge and transforming the academic knowledge into more practicable solutions (Tetler, 2017).

Internationally, the same lack of knowledge is recognised: (DuPaul, Weyandt, & Janusis' (2011) extensive work on effective school-based classroom intervention for learners with ADHD concludes as well, that less research is available on methods to remediate academic problems associated to ADHD compared to research in treatment of behavioural and social difficulties. They suggest as well a more comprehensive approach to social relationship interventions for children with ADHD, which lack research especially in school settings (DuPaul, 2012).

In 2016 in Denmark, an examination of the inclusion initiative (Holst, 2016) causes that the target on 96 per cent inclusion has been removed from the Law on Inclusion (Ministeriet for Børn og Undervisning, 2012a), while the rest of the vision is maintained:

> "In many ways, the field of inclusion moved from being a sympathetic thought that all children should be a part of a learning community, into being a term of abuse, because there have been a number of problems at the individual schools." (Minister of Education, Ellen Trane Nørby (Holst, 2016).

Based on the recommendations in the report from the expert group behind the examination of the inclusion initiative (Jørgensen, Blankenberg, Skall, & Schjerbeck, 2016) it may be fair to conclude that knowledge, assistance, competence development, and resources were still lacking.

Simultaneous, the rapid progress and development of digital technologies have fostered a range of new tools and a high expectation to the value of these tools in almost any part of our lives. A potential, the Danish Government tries to utilise in a widespread digitalisation and implementation of new technologies broadly in the public sector (Digitaliseringsstyrelsen, 2011; Digitaliseringsstyrelsen, 2017) – including both the field of basic and special education (KL, 2017). In this way influenced and supported by the Government over the last decade, Danish schools have invested tremendously in hardware and software in expectation of deriving this potential (Kudahl, 2017; STIL, 2017).

Thus, inspired by the

- Government's enhanced digitalisation of the public sector (Digitaliseringsstyrelsen, 2011) and the continual growing expectations to the impact of technology (ibid.)

- Governments and the Municipalities request for enhanced inclusion of learners with special needs in the basic school system (Regeringen, 2012),
- Ministry of Education's call for knowledge on 'what works' (Undervisningsministeriet, 2017b)
- The schools and the teachers' need for competences and tools to address these new demands (Danmarks Evalueringsinstitut, 2011; Danmarks Evalueringsinstitut, 2013)

it seems delicate to investigate the affordances of these penetrating technologies as a tool for teachers' support of inclusion processes for learners with developmental and attention difficulties.

1.2. PROBLEM FORMULATION

It seems crystal clear that there is an overwhelming need for improving the conditions for inclusion of learners with developmental and attention deficits in the basic school system. Likewise, when defining teachers as main stakeholders in classroom activities it seems crucial to support them in developing new including learning environments and strategies. Furthermore, it would be attractive to take advantage of the increasing access to digital technologies in school and society and examining their value for assisting these processes. Astonishingly, in spite of the amount of research on technology and learning or special education and learning, there is very little research, when it comes to teachers' use of technologies for inclusion purposes of this target group in basic classroom settings (Andersen & Jensen, 2018; Emtoft, 2017). As a contribution towards filling this knowledge gap, this study investigates:

How can teachers be supported in their teaching practices in developing innovative pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties?

The problem formulation prompts a call for elucidating following circumstances:

1. How could inclusion be defined and carried out by the teachers?
2. How are teachers challenged when it comes to inclusion of learners with developmental and attention difficulties and what are their challenges in life and learning?
3. How can teachers meet these learners' special educational needs in their teaching practices?
4. What is the potential of technologies in the context of inclusion?

1.3. CLARIFICATION OF CONCEPTS

The problem formulation calls as well for a brief clarification of a range of concepts which appears from table 1:

Teachers	By *'teachers'* is meant the group of educators in basic school settings, which in Danish public schools contains both teachers and pedagogues.
Support	The word *'support'* covers what would help the teachers and underpin their including teaching and pedagogical practice.
Innovative	*'Innovative'* outlines an intentional activity, designed to benefit in some way by addressing unsolved problems through the development or improvement of a product, method or process (Mulgan et al., 2006). It contains a degree of change and novelty.
Innovative designs	*'Innovative designs'* denote that teachers must develop and design new pedagogical and didactical methods, strategies and learning activities.
Interventions	*'Interventions'* is used as an overall concept that encompasses the different kinds of solutions that are designed, which will include educational products, processes, programs and policies (McKenney & Reeves, 2012). The interventions should be *'including'* and *'technology-based'*, which means that the teachers must use different kinds of technologies with the purpose of including the learners in the learning activities.
Including	The term *'including'* covers that the learners are participating and contributing socially and academically in the learning community at the school.
Learners with developmental and attention difficulties	*'Learners with developmental and attention difficulties'* should be understood as an umbrella term for students who breaks with age appropriate current rules, norms, and expectations to children (Nordahl, Mausethagen, & Kostøl, 2009) in the field of Attention Deficit Hyperactivity Disorder (ADHD) or Autism Spectrum Disorder (ASD). Throughout this thesis, they would be denoted as focus learners.
Technologies	*'Technologies'* are a wider concept that covers both hardware and software in e.g. terms like Digital Technologies or Information and Communication Technologies (ICT).

Users of technologies	Technologies can be used including in the '*teaching practice*', when *teachers* are presenting, communicating and organising learning experiences in the classroom. Technologies can as well be used by the *learners*, when they are working with the curriculum, solving task or presenting their knowledge in the '*classroom activities*'

Table 1 Clarification of concepts related to the problem formulation

1.4. STRUCTURE FOR THIS THESIS

This article-based Ph.D. thesis consists of seven research papers reflected in a framework. The framework falls into two parts. First part contains the theoretical and methodological basis behind the accomplished research, while the second part presents and reflects the articles on which the framework rests. The dissertation articles are gathered in a separate publication: *Expanding Scenarios for Visible Learners – the research behind.*

1.4.1. PART ONE

Part one presents the rationale, background and motivation for this thesis in chapter one, where the field is outlined and the research question presented. Chapters two-four form the theoretical optics behind the research when defining and discussing interpretations of inclusion, teachers' challenges in an including school and the potential of technologies for inclusion and learning. Chapter five introduces the methodology and used research methods.

1.4.2. PART TWO

Part two presents and reflects following research papers; all of them written, submitted or published in relation to the Ph.D. study:

1. Andersen, H. V. & Jensen, R. H. S. (2018). Assistive Learning Technologies for Learners with ADHD and ASD – A review 2006-2016. Submitted as a book chapter in Brooks, E. (ed.), *Emerging practices, tools and technologies in innovative designs and learning*. Springer, 2018

2. Andersen, H. V. & Sorensen E. K. (2017a). Technology as a Vehicle for Inclusion of Learners with Attention Deficits in Mainstream Schools. In *Proceedings of the European Distance and E-Learning Network 2015 Annual Conference Barcelona, 9-12 June, 2015* (pp. 720–730). Barcelona: EDEN. Retrieved from http://www.eden-online.org/wp-content/uploads/2016/05/BRPA_Voldborg-

Andersen_Korsgaard_Sorensen-1.pdf.[1] Re-published (2017). Technology as a Vehicle for Inclusion of Learners with Attention Deficits in Mainstream Schools. In A. Szucs & U. Bernath (Eds.), *Best of EDEN 2015 Special Issue of the European Journal of Open, Distance and E-Learning* (Vol. 2017, pp. 1–13). European Journal of Open, Distance and E-Learning (EURODL). Retrieved from http://www.eurodl.org/materials/special/2016/Barcelona_114_Andersen_Sorensen.pdf

3. Andersen, H. V., & Sorensen, E. K. (2017b). Inducing omnipotence or powerlessness in learners with developmental and attention difficulties through structuring technologies. *EAI Endorsed Transactions on Creative Technologies*, *4*(12), 153158. https://doi.org/10.4108/eai.3-10-2017.153158

4. Andersen, H. V. (2015). Supporting Inclusion of Learners with Attention-Deficit/Hyperactivity Disorder in Sound-Field-Amplification-Systems. In *Proceedings of the 1st D4Learning International Conference Innovations in Digital Learning for Inclusion* (pp. 1–8). Aalborg: Aalborg University Press.

5. Andersen, H. V. & Sorensen, E. K. (2017c). Enhancing Understanding, Flow and Self-Efficacy in Learners with Developmental and Attention Difficulties through ICT-based Interventions. *European Journal of Open, Distance and E-Learning (EURODL)*. Retrieved from http://www.eurodl.org/materials/contrib/2017/Andersen_Sorensen.pdf

6. Sorensen, E. K. & Andersen, H. V. (2017a). Strengthening inclusion of learners with attention difficulties through interventions with digital technology in processes of production. *European Journal of Open, Distance and E-Learning (EURODL)*, *2017*. Retrieved from http://www.eurodl.org/materials/contrib/2017/Sorensen_Andersen.pdf

7. Sorensen, E. K. & Andersen, H. V. (2017b). Solitude or co-existence – or learning-together-apart with digital dialogic technologies for kids with developmental and attention difficulties. *EAI Endorsed Transactions on Creative Technologies*, *4*(12), 153157. https://doi.org/10.4108/eai.3-10-2017.153157

Chapter six contains a thorough and deep reflection on each single paper from a retro perspective in the aim of capturing an understanding of how teachers could be supported in relation to the research question. A discussion is carried out in chapter seven, while chapter eight forms the conclusion, which will be put into perspective in chapter nine.

[1] Awarded in two categories at *the European Distance and E-Learning Network 2015 Annual Conference Barcelona, 9-12 June, 2015* for Best Research Paper and Best Practice Paper among 276 papers.

PART 1 THEORETICAL OPTICS AND METHODOLOGICAL APPROACHES

INTRODUCTION TO PART 1

In order to investigate how teachers can be supported in their teaching practices in developing innovative pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties, it is first of all necessary to clarify:

- How can inclusion be defined and carried out by the teachers?
- How are teachers challenged when including learners with developmental and attention difficulties in their teaching practice?
- What is the general potential of technologies in the context of learning and inclusion?

Part one encompasses in chapters 2-4 a range of theoretical perspectives and assumptions referring to these questions, while chapter 5 accounts for the methodology and the research design:

Chapter 2: Interpretations of inclusion

Chapter 3: Teachers' role and challenges in an including school

Chapter 4: The potential of technologies for supporting inclusion

Chapter 5: Methodology

CHAPTER 2. INTERPRETATIONS OF INCLUSION

To enable research concerning including technology-based interventions, it is, first of all, necessary for to clarify how inclusion can be defined and carried out. What does inclusion mean? Who is going to be included and why? How can we know if a learner is included or not? This chapter presents interpretations of inclusion and discusses how teachers are positioned in an including school.

2.1. AN INTERNATIONAL PERSPECTIVE OF INCLUSION

> "Everyone has his or her own view of a complex idea like inclusion" (Booth & Ainscow, 2002)

Even if inclusion has been increasingly present in the educational debate the last decades, it does not seem to be an unambiguous concept to define. The term describes a vision of an ideal situation, where everybody is included and no one is excluded – in the society, in a community, in a learning environment (Tetler, 2000; Alenkær, 2010b). The term has become the new ethical 'correct' stance when it comes to learners with special needs – distanced from former pedagogical approaches like segregation or integration (Engsig, 2015; Qvortrup, 2012; Ratner, 2012).

Since the beginning of the 20th century where segregation for decades has separated 'the abnormal and impossible-to-teach' (e.g. deaf, blind, physical or psychic handicapped people) from 'the normal and possible-to-teach', integration was from the middle of the 20th century the valid principle with regard to individuals with special needs (Næsby, 2012). But the integration is not a specific concept, as it can be carried out in various forms as e.g.:

- Formal integration – learners are enrolled but do not show up (Alenkær, 2010b)
- Functional integration – learners are using the same building stock but asynchronous (Söder, 1979)
- Physical integration – learners are present – 'where' is primarily, 'what' and 'how' are secondary (ibid.)
- Social integration – learners adapt the school and participate in education and social community – they have work-related and friendly relations (ibid.)
- Mediated integration – learners participate in education and social community without being physically present, but they have work-related and friendly relations through virtual working spaces or social media (Andersen & Grum, 2011)

In 1990 the term inclusion was introduced by Stainback & Stainback from an idea of the necessity of change when it comes to content in and organisation of the educational system if the multifarious needs and interest of all students should be met (Stainback & Stainback, 1990). Shortly after, this call for change is manifested in UNESCO's Salamanca Declaration:

> "A change in social perspective is imperative. Far too long, the problems of people with disabilities have been compounded by a disabling society that has focused upon their impairments rather than their potential" (UNESCO, 1994).

92 nations (including Denmark) ratified 1994 The Salamanca Declaration (UNESCO, 1994) and initiated then a radical transition in how education of students with special needs should be managed by states, schools and teachers. The ratification demonstrates a normative valuation, where the states acknowledge the following:

1. "Every child has a *fundamental right to education*, and must be given the opportunity to *achieve and maintain an acceptable level of learning*
2. Every child has *unique characteristics, interest, abilities and learning needs*
3. Education systems should be designed and educational programmes implemented to *take into account the wide diversity of these characteristics and needs*
4. Those with special educational needs must have *access to regular schools* which should accommodate them within a *child centred pedagogy* capable of meeting these needs
5. Regular schools with this inclusive orientation are the *most effective* means of combating discriminatory attitudes, creating welcoming communities, *building an inclusive society and achieving education for all*; moreover, they provide an *effective education* to the majority and improve the efficiency and ultimately the *cost-effectiveness* of the entire education system." (ibid.)

The Declaration present a vision on an inclusive society, an inclusive school, and an inclusive pedagogy, but provides no clear definition of the concept inclusion. Rather the text encompasses concurrent discourses of the concept inclusion (Dyson, 1999; Clausen, 2013) which gives rise to different perspectives, interpretations and understandings of the concept as illustrated in figure 1:

- An ethical discourse: The United nations ideal with consideration for the individual – carried out as visions for 'fundamental rights to education'

- A political discourse: The Governments' ideal with consideration for the community – carried out as laws and initiatives on 'education systems with inclusive orientation'
- An economical discourse: The Municipalities' reality with consideration for the community – carried out as resources for 'effective and cost-effective schools'
- A pragmatic discourse: The Teachers' reality with consideration for the individual – carried out as 'child centred pedagogy' ensuring all above

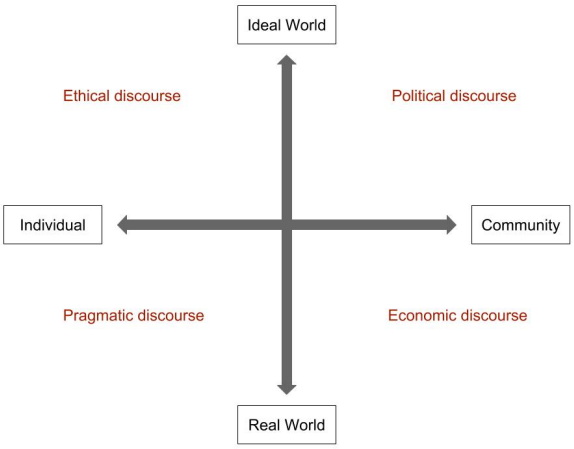


Figure 1 Four discourses of the concept of inclusion (after Clausen, 2013)

The vision of inclusion makes exceptional demands to the education system as schools should accommodate all children regardless of their physical, intellectual, social, emotional, linguistic or other conditions (UNESCO, 1994), where 'accommodate' refer to find methods, which fit these children's special educational needs when they are included in educational programmes designed for children in general. A possible helping hand was carried out from Peter Farrell's operational definition (Farrell, 2002) of inclusion, which has been widely accepted in the inclusion literature, when he defines inclusion to be about:

- **Presence** - the extent to which pupils attend lessons in mainstream classes in local schools and communities
- **Acceptance** - the extent to which other staff and pupils welcome all pupils as full and active members of the school
- **Participation** - the extent to which all pupils contribute actively in all the school's activities
- **Achievement** - the extent to which all pupils make progress in academic skills and in their social/emotional development (ibid.)

Booth & Ainscow (2002) agree with Farrell (2002) and define inclusion to be a reciprocal process which involve continuous change:

> "It is an unending process of increasing learning and participation for all students. It is an ideal to which schools can aspire but which is never fully reached. But inclusion happens as soon as the process of increasing participation is started. An inclusive school is on the move. Participation means learning alongside with others and collaborating with them in shared learning experiences. It requires active engagement with learning and having a say in how education is experienced. More deeply, it is about being recognized, accepted and valued for oneself" (Booth & Ainscow, 2002)

2.2. A NATIONAL DANISH PERSPECTIVE OF INCLUSION

In a Danish context all discourses above have been present and e.g. reified in transition processes related to the law on inclusion (Ministeriet for Børn og Undervisning, 2012a) and the reform of the public school system (Ministeriet for Børn, Undervisning og Ligestilling, 2015), but also in the public debate, where politicians, school leaders, teachers, parents and children have discussed the vision on inclusion from different perspectives. Frameworks have been provided (Tetler, 2000), dilemmas have been brought to light (Ratner, 2013), initiatives have been investigated (Engsig, 2015) and specific methods are introduced (Alenkær, 2010a; Alenkær, 2017) all supporting the necessity for teachers to develop their professional practice in order to meet the challenges of inclusion. Especially the work of Alenkær has broadly been used as inspiration in the development processes at schools and municipalities as his three-circle-model for inclusion (IC3) translates the vision into a framework on how inclusion can be carried out and how teachers can investigate to which extent a learner is included. Closely connected to the definitions of Farrell (2002) and Booth & Ainscow (2002) the IC3-model (figure 2) encompasses an overall framework for the inclusion initiative with specific recommendations to practitioners according to both the physical conditions, the social interaction and the task solving processes:

> "The IC3-model is a methodical basis for a dialogically investigation of the experiences of qualitative inclusion by given focus person. The model understands 'inclusion' as the phenomenon which occurs, when the needs of the individual is experienced by himself as met regarding the three categories 'physical conditions', 'social interaction' and 'task solving processes'. If he should be met in all these need, he should be considered as included. The effort, which is necessary, if the individual person should experience himself qualitative included, will vary from person to person. That is why, there is no unambiguous way, after which we can 'include'" (Alenkær, 2017).

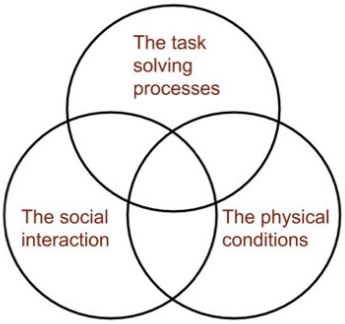


Figure 2 The IC3-model of inclusion (Alenkær, 2017)

The model has inspired to development of a framework for inclusion (Andersen, Sorensen, Jensen de Lopéz, & Jensen, 2017; Andersen & Sorensen, 2017a), which has shown to be valuable for supporting teachers in their development of innovative pedagogic designs in contexts of inclusion as it initiated both a shared language among practitioners and a shared interpretation of the inclusion concept as follows:

A person can be considered as included, when he joins, participates and contributes in the academic and social community – as a citizen in the society and as a student in the learning environment in the school (Andersen & Sorensen, 2017a) as illustrated in figure 3. To contribute means to communicate and offer something (thoughts, statements, insights, help etc.) to the community – and by that develop an identity as someone who is participating and contributing (Sorensen & Andersen, 2017a). The learning community in schools contains both an academic and a socially dimension. The learners can be present both physically or mediated (Andersen, 2015). They are understood as being unique, with unique characteristics, abilities and needs (Sorensen & Andersen, 2017b) – and provided with an opportunity to participate actively while contributing and achieving at different levels according to their actual competences (Andersen & Sorensen, 2017c).

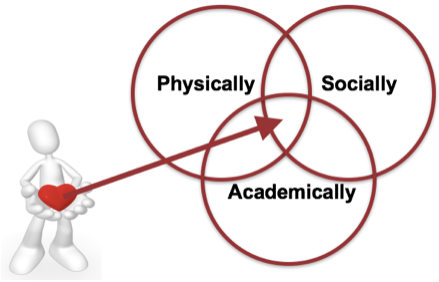


Figure 3 Interpretation of inclusion

Resting on this approach to inclusion, the next chapter examines how teachers are challenged when including learners with developmental and attention deficits in their classroom practices and how teachers can meet these unique learners with unique characteristics, abilities and needs in their innovative and including pedagogical designs.

CHAPTER 3. TEACHERS' ROLE AND CHALLENGES IN AN INCLUDING SCHOOL

The vision of inclusion is attempted implemented in a time where the educational agenda is highly marked by a distinct demand for learning to be visible and having an extensive focus on very specific curricular achievements (Undervisningsministeriet, 2017a). Teachers are supposed both to raise the curricular standards and include learners with special needs (Tonsberg, 2015). In order to deal with this double-sided challenge, it might be valuable to have a closer look at the learning processes and the teacher/learner relation in those. What is at risk for the teacher and the learner, and how may the teacher act? Consequently, this chapter

- Presents how teachers feel themselves challenged in an including school
- Clarifies how learners with developmental and attention difficulties may be challenged in an including school context
- Discusses how teachers can understand their role in the teacher/learner relation

The chapter argues how teachers in an including school may empower the learner to believe in his own ability to succeed in the situation and accomplish with a given tasks in a feeling of flow (Csikszentmihalyi, 2014) or self-efficacy (Bandura, 1977). These conditions might as well be in evidence if looking at teachers as 'learners' and specialists, researchers or school leaders as 'teachers'. It would be the same approach, the same task, the same issue: 'Teachers' have to meet 'learners'' differences and understand what they understand (Kierkegaard, 1859). Teachers must act as emphatic self-objects or role models in which the learner can mirror himself and find necessary help when invincible frustration occurs (Kohut, 1990).

> "To include any child or young person we have to be concerned with the whole person. This can be neglected when inclusion is focused on only one aspect of a student such as an impairment or a need to learn English as an additional language. The exclusionary pressure on a child with an impairment may be primarily directed at his or her background or may arise because the curriculum does not engage his or her interests" (Booth & Ainscow, 2002, p. 3-4).

3.1. TEACHERS' PERCEPTIONS OF CHALLENGES IN AN INCLUDING SCHOOL

It seems evident, that it is challenging to develop a well-functioning including practice. Other research results recognise how schools tries to develop an including practice but, in reality, do not modify the teaching to the individual learners and learners in challenges (Hedegaard-Sørensen & Grumløse, 2016). A research mapping from 2013 exposes how 87 per cent of the teachers call for more pedagogical knowledge to handle the inclusion task and include learners with special needs, while 88 per cent of the teachers state they need more knowledge to establish and develop including teaching strategies (Danmarks Evalueringsinstitut, 2013, p. 26).

The shift to the including paradigm and a high demand for teachers to reflect their own practices have, according to Ratner (2012; 2013), implied that teachers easily feel guilty when their including strategies are not working. Some of them feel themselves powerless, because they experience they do not have the necessary skills to work with inclusion. Both teachers and leaders are lacking resources and a language to handle the problems in a daily life situation in schools (Ratner, 2012).

When examining the working environment, these new professional demands in an including practice have shown to be stressful to teachers, where e.g. specific quantitative and emotional demands grounded in enhanced inclusion and reduced time for preparation are mentioned as decisive reasons (Arbejdsmedicinsk klinik, 2016).

When initiating this study, it was investigated how 46 teachers from 11 schools experienced the challenges of inclusion in general, and more specific inclusion of learners with developmental and attention difficulties. From the findings eight themes were identified as significant (Andersen et al., 2017 p. 64):

1. The teachers perceive a lack of sufficient competencies/skills
2. The teachers lack of support from pedagogical psychological advisory team (PPR) on knowledge on the focus learners and useful tools
3. The teachers are constantly interrupted in their teaching by the focus learners' disturbances, anger, lacking motivation and racket in the classroom
4. The teachers experience that resources, settings, staffing etc. in the school hamper implementation of innovative pedagogical methods
5. The teachers sympathise with the learners' special needs, but lacking time and rigid schedules hamper their possibilities for supporting the learners decently
6. The teachers miss an overall inclusion pedagogy – as a shared overall framework for their work

7. The teachers are getting frustrated by the parents' demands to the school and the parents' lacking understanding and responsibility
8. The teachers perceive they are not able to meet their own professional expectations

The teachers' concern on their own professional capability grow further when they are looking specifically at the position of learners with developmental and attention difficulties in their schools. They sympathise with the focus learners and are deeply concerned on the personally development and future perspective for this group of children. From teachers' statement eight themes are identified of importance for focus learners' well-being in the school (ibid. p. 65-66):

1. Their role in the class and development of self-esteem
2. Lacking motivation for and meaning in tasks in the school
3. Lacking concentration and focus in the school
4. Their impulsivity and hyper activity in the classroom
5. Decreased possibilities for participation
6. Lacking overview and need for security
7. Their academic challenges
8. Their difficulties in understanding and adapting the frames in the school

Teachers' concern for the focus learners' development and their own feeling of professional powerlessness can be seen as a strong need for research concerning support of teachers in designing and implementing new approaches for their inclusion practice (Andersen & Sorensen, 2016; Sorensen & Andersen, 2016). In order to level these approaches at learners with developmental and attention difficulties, next section illustrates how they are challenged in life and learning.

3.2. RECOGNISING THE INDIVIDUAL LEARNERS

> "Inclusion starts from a recognition of the differences between students. The development of inclusive approaches to teaching and learning respect and build on such differences. This may involve deep changes in what goes on the the classrooms, staffrooms, playgrounds, and in relationships with parents/carers. To include any child or young person we have to be concerned with the whole person" (Booth & Ainscow, 2002, p. 3-4).

According to Booth and Ainscow (ibid.) teachers should be aware of the learners as whole persons and be able to recognise the individual learner's differences, strength, and challenges. This section clarifies:

1. How learners with special needs and learners with developmental and attention difficulties can be defined
2. How learners with Autism Spectrum Disorder (ASD) can be identified

3. How learners with Attention Deficit Hyperactivity Disorder (ADHD) can be identified
4. Which classroom strategies may be useful for learners with developmental and attention difficulties

3.2.1. IDENTIFYING LEARNERS WITH DEVELOPMENTAL AND ATTENTION DIFFICULTIES

Children with special educational needs can be described as 'children who break with age appropriate current rules, norms, and expectations to children in the basic school with a regular character over time' (Nordahl et al., 2009; Dyssegaard, Larsen, & Tiftikçi, 2013). The report 'Initiatives for inclusion in the public school' (Initiativer for inklusion i folkeskolen; Danmarks Evalueringsinstitut, 2011) points out six groups of pupils with special educational needs, which teachers are supposed to meet in the basic school system:

- Pupils with general learning difficulties (LD)
- Pupils with extensive developmental and attention deficits (e.g. ADHD/ADD)
- Pupils with socio-emotional and environmental difficulties
- Pupils with psychical difficulties
- Pupils with reading and writing difficulties
- Pupils with speak and language difficulties

Children with developmental and attention difficulties are an imprecisely umbrella term of an inhomogeneous group of children (e.g. Danmarks Evalueringsinstitut, 2011; Dyssegaard, Larsen, & Tiftikçi, 2013; Dyssegaard, Larsen, & Hald, 2013) , who for varying causes and at different levels are challenged in life and learning (Kutscher, Attwood, & Wolff, 2014; Almer & Sneum, 2009). The delimitation could be formed by the diagnoses Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD), but attention or developmental difficulties will also appear without these diagnoses (Kutscher et al., 2014). The diagnoses ADHD and ASD include many variations of challenges or associated comorbid disorders (as e.g. Learning Disabilities, Anxiety, Obsessive Compulsive Disorder (OCD), Tics, Tourette Syndrome, Depression, Bi-polar Disorders etc. (ibid.; Almer & Sneum, 2009; Barkley, 2013)), which often hinder a clearly delimitation and draw a very complex picture of the issues (Thomsen, 2015). Caused to the wide spectrum of challenges, it can be difficult for teachers to choose a fixed solution for these children (DuPaul & Stoner, 2003; DuPaul, Weyandt, & Janusis, 2011). The teachers need to know more about the varying characteristics of the diagnoses to recognise the children's individual needs, is the reason why a brief introduction is provided in the following.

3.2.2. IDENTIFYING LEARNERS WITH AUTISM SPECTRUM DISORDER

Autism Spectrum Disorder (ASD) has since May 2013 been an umbrella term for all earlier autism disorders including autistic disorder, childhood disintegrative disorder, pervasive developmental disorder not otherwise specified and Asperger syndrome (American Psychiatric Association, 2013). The term spectrum illustrates that there are many types of autism in this lifelong pervasive social disability. Individuals with ASD are characterised by persistent deficits in social communication and social interaction across contexts, and restricted, repetitive patterns of behaviour, interests, or activities (ibid.), which can manifest themselves as shown in table 2.

- Abnormal social approach
- Reduced sharing of interests
- Failure in initiation or responding social interactions
- Poorly integrated verbal and nonverbal communication
- Abnormalities in eye contact or body language
- Lack of facial expressions
- Difficulties in adjusting behaviour for various social contexts
- Difficulties in making friends or absence of interest in peers
- Stereotypes or repetitive motor movements
- Insistence on sameness
- Inflexible adherence to routines, ritualised patterns of verbal and nonverbal behaviour
- Highly restricted
- Fixated in interests with abnormal intensity or focus
- Hyper- or hypo-reactive to sensory input

Table 2 Examples of behaviour related to Autism Spectrum Disorder

ASD affects one of 166 children and has no cure. Symptoms should be present in the early childhood, but might not become fully manifested until social demands exceed the limited capacities. They could, as well, be masked by sufficient learning strategies later in life (ibid.). The diversity of combinations is extensive from low functioning, infantile autistics with no or very little language and intelligence, to high functioning autistics with normal to high intelligence. Teachers in the basic school system will primarily recognise very functioning autistics, while low functioning, infantile autistics, primarily, still visit special educational schools.

Lynch and Irvine's (2009) research examines best practice for educational interventions for learners with ASD and identifies six common elements, which teachers have to consider as a basic minimum in their including teaching strategies (table 3).

1. High predictability and routine
2. Specialised curriculum
3. Supportive teaching environment
4. Functional approach to challenging behaviour
5. Transition support
6. Family involvement

Table 3 Significant supporting elements for learners with Autism Spectrum Disorder

First of all, learners with ASD are dependent on a highly predictability and routine. Secondly, they will often need to have specialised curriculum content adjusted their individual status of autism. Thirdly, they will need a highly supportive teaching environment with detailed generalization strategies to manage their day and tasks at school. Fourth, the teachers should be aware of providing a functional approach to their challenging behaviours to prevent conflict to escalate or occur. Since learners with ASD are very dependent on predictability and routine, schools as a fifth element should be careful providing transition support from the previous school environment or between shifting environments inside the school. Sixth and finally, a highly family involvement should be considered as necessary.

3.2.3. IDENTIFYING LEARNERS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

Attention Deficit Hyperactivity Disorder (ADHD) is characterised by the core symptoms of attention difficulties and/or impulsivity, but the symptoms appear in different combinations (Wilens, Biederman, & Spencer, 2002). The prevalence is varying, but consensus on 4-10 % in childhood and 4-5 % in adulthood seem evident (Almer & Sneum, 2009).

Attention deficit is expressed when a child is unable to stay concentrated, is often distracted by external stimulus, not seems to be listening when directly addressed and needs to have instructions and explanations repeated. The hyperactivity and impulsivity manifest itself both physically and verbally, when a child is fidgeting agitated with things, moving restless on the chair or toddling with his/her feet, talking much, finding it difficult to wait and often interrupts other peoples' speech or play. The symptoms of ADHD seem sensitive in relation to the situation and the context; a child with ADHD can be calm, immersed and attentive in some situations and interrupting, fidgety and inattentive in other situations (Barkley, 2006). The demands and level of cognitive complexity seem to play a significant role with an impact on areas listed in table 4.

• Memory • Attention • Organisation • Initiation • Persistence • Hyperactivity • Impulsivity	• Behaviour • Emotions • Pro-social behaviour[2] • Having friends • Understanding and conception • Language and communication • Rigidity

Table 4 Areas of challenges related to Attention Deficit Hyperactivity Disorder

The challenges related to the ADHD impact the children's presence and achievement in school. Their school work is often marked by low productivity caused by slow processing speed (Mayes and Calhoun, 2007) and many errors due to carelessness and poor organisation abilities (DuPaul & Stoner, 2003), why they easily could be misunderstood as lazy or indifferent. It would e.g. be of utmost relevance to focus on the fact, that many children with ADHD exhibit working memory problems (Alloway, Gathercole, & Elliott, 2010) in form of lack of capacity to store and manipulate information for a brief period, which is an essential function for a range of classroom activities and fundamental for learning.

Dyslexia is a highly comorbid condition to ADHD (Germanò, Gagliano, & Curatolo, 2010), which impact reading, writing but also acquisition of knowledge in a mainly text-based education setting. It might be difficult to separate cause from effect, but it is evident that e.g. the narrative competences[3] and internal state language are very poor in children with ASD and ADHD (Rumpf et al., 2012), given that they produce shorter stories with fewer pronominal references, fail to point out main aspect and exhibit deficits in the deeper understanding of a story than their peers (ibid.).

Schools may also be aware that youth with ADHD often exhibit more homework problems than their peers (Langberg et al., 2011). Research on how to intervene is, unfortunately, minimal; organisation of materials though seems to be a critical component and, therefore, an important target for interventions (ibid.).

Children with ADHD are not only challenged academically. Critical secondary problems as low self-esteem, behavioural problems, dropping out of school or worse outcome are identified more often for children with comorbid problems, than for children with only ADHD (ibid.). Most of them exhibit serious social deficits, why they commonly experience to be rejected by peers, only have few friends if any, and, therefore, are less involved in play (Docking, Munro, Cordier, & Ellis, 2013). Social

[2] Prosocial behaviour refers to acts, where people help, comfort or collaborate with others

[3] Narrative competences refer to the ability to produce and organise events chronologically and link them together in a coherent story of adequate length with adequate verbalisations.

isolation by individuals with ADHD seems to increase with age, which among many other issues might be exacerbated by poor self-regulation. Schools may benefit from a more comprehensive approach to social relationship interventions (DuPaul et al., 2011; DuPaul, 2012). Early interventions targeted behavioural, emotional and neurocognitive functions seem e.g. to foster development of self-regulation by pre-schoolers (Healey and Halperin, 2015) and help to change these negative social perspectives. Furthermore, such interventions have also shown improvements when it comes to working memory, hyperactivity, and aggression as well (ibid.).

Comprehensive behavioural, emotional and neurocognitive interventions have been common practice by specialist at the special education schools, but do not seem to be provided or professional facilitated at the basic public schools. Next chapter provides a brief overview on possible classroom strategies for learners with developmental and attention difficulties identified across the literature study behind this thesis.

3.2.4. CLASSROOM STRATEGIES FOR LEARNERS WITH DEVELOPMENTAL AND ATTENTION DIFFICULTIES

It is well known that children with ADHD and ASD are sensitive in classroom activities, but there is very little research on the effects in engagement and achievement when changing general classroom environment. It though seems evident, that the classroom engagement decreases with age and the students with ADHD and ASD are more sensitive to the type of teaching format as they are less engaged in teacher led large classroom settings and more engaged in small group work (ibid.).

DuPaul and colleagues' (DuPaul et al., 2011; DuPaul, 2012) extensive work on effective school-based classroom interventions for learners with ADHD conclude, that less research is available on methods to remediate academic problems associated to ADHD compared to research in treatment of behavioural and social difficulties. But, they highlight

- computer assisted instructions
- self-evaluation, and
- self-regulation intervention

as having a large positive effect on the on-task behaviour and academic performance of student with ADHD, why teachers may consider these elements when developing innovative including design for this target group (ibid.).

Various kinds of interventions are identified as effective across the literature (e.g. Mayes and Calhoun, 2007; DuPaul et al., 2011; DuPaul, 2012; Steiner et al., 2014), from which my study has recognised five overall themes:

1. Behavioural interventions
2. Self-regulation interventions
3. Academic interventions
4. Home-school communications interventions
5. Collaborative consultation interventions

Behavioural interventions cover actions, where teachers are using specific strategies to change a learners' behaviour in a given learning setting. The behavioural interventions can be provided the learner as a scaffolding before/during the activities (antecedent-based strategies) like e.g. 'posting classroom rules near focus learners', or as a reaction after a given activity (consequence-based strategies) like e.g. 'provide or remove tokens'.

Self-regulation interventions are helping learners to monitor and evaluate their own behaviour in order to develop a better understanding of what is expected and appropriate responses. The interventions could e.g. be learners 'ranging' their own work performance from poor to excellent'.

Academic interventions are pointing more directly at the specific school work in order to help the learner to understand the curriculum, the task or program and be able to manage the assignments. 'Using assistive technologies' or 'instruct learners in note-taking' are examples of academic interventions.

Home-school communication interventions cover different kinds of feedback on performance between school and home like e.g. 'daily report card system'.

Collaborative consultation interventions refer to interventions generated as collaborative work among school professionals carried out as e.g. 'shared problem identification' or 'weekly evaluation meetings'.

Table 5 shows a range of intervention strategies in classroom settings identified in the literature study (Andersen & Jensen, 2018) organised after the five themes above. They may be considered as inspiration for development of a repertoire of strategies for meeting the needs of learners with developmental and attention deficits.

Behavioural interventions Antecedent-based strategies	• Post and strategically review classroom rules – positively phrased and few in number • Praise students following classroom rules • Post them near children with ADHD • Reduce task demands by modifying length and/or content of assignments • Match assignments to students' attention span • Provide students with task choices

	• Preferential seating near the teacher and between attentive classmates • Reasonable time limit on homework • Reduced classroom assignments • Less teacher led classroom instruction time • More small group work time • Setting learning expectations • Being predictable • Double set of textbooks, pencil case etc. • Backpack check before and after school
Behavioural interventions Consequence-based strategies, response-cost and time-out	• Contingent positive individualised reinforcement in the form of teacher praise or tokens provided as frequently and as close to the occurrence of target behaviour as possible • Response cost by removing re-inforcers should only be used when reinforcements seems useless • Time-out and removing students to a separate part of the classroom
Self-regulation interventions	• Encourage students to monitor, evaluate and/or reinforce their own behaviours • Evaluate their classroom behaviour and work performance regularly on a Likert scale (ranging from poor to excellent) • Train students to monitor their homework and classroom preparedness
Academic Interventions	• Provide teacher-mediated direct instructions in relevant skills • Instruct students in note taking • Provide computer assisted instructions • Use peer tutoring to enhance task engagement and performance • Reviewing previous lessons • Simplifying instructions • Tasks broken into small manageable segments • Organisational and study skills instruction • Using audio-visual materials • Performing on-going student evaluations • Using oral and written directions • Dividing work into smaller units • Highlighting key points • Using assistive technology
Home-School Communication Programs	• Use a daily report card system with feedback about completion, academic performance, participation in class, getting along with classmates in a list of 3-5 goals

	• Design interventions to address peer relations
Collaborative Consultation	• Organise equal partnership among school professionals

Table 5 Intervention strategies for learners with developmental and attention difficulties

When developing new pedagogical designs, it may be less challenging if these strategies are not only provided the few learners with special educational needs but are used as general – and valuable - approaches for all learners:

> "The work done in identifying and reducing the difficulties of one student may benefit many other students, whose learning was not initially a particular focus of concern" (Booth & Ainscow, 2002, p. 4) .

DuPaul and colleagues (DuPaul et al., 2011; DuPaul, 2012) furthermore state, that partnerships among school professionals working collaboratively on interventions is a huge overlooked aspect in treatment of children with ADHD and suggest schools to establish collaborative consultations building on four core steps:

1. Defining differences
2. Discussing challenges
3. Choosing interventions
4. Evaluating influence/impact

This sections have now clarified how teachers may be challenged when teaching learners with developmental and attention difficulties, and provided insights on these learners' specific differences. Summing up, following elements can be considered as recommendations when supporting development of innovative pedagogic design for learners with developmental and attention difficulties:

- Provide predictability
- Increase productivity – as e.g. production of stories
- Support organisation
- Support memory
- Assist reading and writing
- Assist acquisition of knowledge – as e.g. understanding of stories
- Support self-regulation
- Assist homework
- Provide less large classroom settings and more small group work
- Work collaboratively on interventions

For a deeper understanding of what is at play in the classroom interaction between teachers and learners, will next section discuss how the roles in the teacher/learner relation can be understood. What might happen if a learners' needs are not being met? How would it impact the learning and personal development? Which role does teachers play?

3.3. TEACHER/LEARNER RELATION

Teaching and learning can generally be seen a conflictual business, where teachers both are leading learners through painful and challenging learning processes, encouraging them to keep on moving when it seems difficult and supporting them when they lose their footing for a moment. Teaching learners in challenges make even higher demands on a teacher's ability to recognise and understand what is happening for the learner in these demanding learning processes and how teachers may act to provide an appropriate support in their teaching practice and classroom activities.

> "If one is truly to succeed in leading a person to a specific place, one must first and foremost take care to find him where he is and begin there… But all true helping begins with a humbling. The helper must first humble himself under the person he wants to help…" (Kierkegaard, 1859, p. 97, my translation).

To operationalise Kierkegaard's words, necessitate that teachers, as humble helpers, recognise a learner's understanding of the world and him-self and meets him there. They may empower (Freire, 1970) the learner to believe in his own ability to succeed in the situation and accomplish with a given tasks in a feeling of flow (Csikszentmihalyi, 2014) and self-efficacy (Bandura, 1977).

In order to do so, it is necessary understand how learning processes affect the learner and what might happen when a learner's needs are not being met. Support for developing this understanding may be found in the object-relation theory of Kohut (Kohut, 1990), through which teachers can be understood as as emphatic self-objects or role models for learners, who are using such self-objects to mirror themselves and find necessary help when frustration occurs (Kohut, 1990). This section discusses how the role and the task in the teacher/learner relation can be defined through the lenses of

- the object-relation theory of Kohut (Kohut, 1990)
- the flow theory of Csikszentmihalyi (Csikszentmihalyi, 2014), and
- the social cognitive theory of Bandura (Bandura, 1977)

3.3.1. OBJECT-RELATION THEORY OF KOHUT

For a learner, the learning process is much more than acquisition of specific curricular knowledge and skills. Learning is a double-sided phenomenon, where the learner both is learning to understand the world (the curriculum) and him self (to become a human being) (Sorensen & Andersen, 2017b). The learner's engagement in school is a part of the formation of his character, a process where he as well develops his self-image, his identity and his relation to others.

According to the object-relation theory of Kohut (Kohut, 1990), the main dynamic in the formation of the personality/identity is formed by fights on an outer and inner plan; on the external, social level a fight between an emphatic reflecting and an idealised self-object, and on the internal, individual level a fight between the self-assertiveness and an inner wish to melt together with a capable self-object.

A self-object is by Kohut (ibid.) defined as an object, in which the self can mirror. It could e.g. be a parent, a pedagogue or a teacher. Such a mirroring can either be emphatic and understanding – or idealising, goal-setting and utopia promoting. Hence, self-objects foster both care/solicitude, but also opportunities and pictures of what is worth striving for (valuable) in life. For the teacher (as a self-object) the task may be allowing this mirroring to happen by e.g. demonstrate enthusiasm or being a role model who provides goals and directions for the learners.

3.3.2. DEVELOPMENT OF THE LEARNER'S SELF

The learner's self consists of the self-image and the identity. It is formed through a separation from other people and understood as a balance between a wish to be like other (similar) and different from other (unique). As unique, being capable and able to dissociate from the self-objects, in which the learner is mirroring himself. As connected, accepted in and belonging to a community with others. In this way, human beings are both striving after homogeneity and connectedness to communities, and both empathy and robustness is needed (ibid.)

These fights are happening in the classroom, where focus learners with developmental and attention difficulties both are striving to be accepted as the persons they are and be connected to the community of classmates. Both dimensions may have attention when designing learning activities for all learners (promote community building) and when providing support to individual learners (avoid stigmatising and isolation of learners with special needs).

The self-development is by Kohut (ibid.) described as a progression, where learners, if they are supported well, are developing a directedness against their life-project or an offendedness if their needs are not being met. The progression in the

development of the self is illustrated in table 6; likewise, the role of the self-objects/teachers at the three developmental levels.

The self of 0. Order.	Here is the learner not able to focus his orientation (directedness) into a given place, but meet invincible frustrations and a narcissistic offended fury without possibility for self-knowledge or learning from the frustration. The learner will need a substituting introspection from emphatic self-objects to be able to work with the task, to prevent the invincible frustration in leaving the self in a depressive emptiness and a feeling of abandonment. When it comes to children, we can identify this in hesitant introversion or boundary pushing extraversion. Teachers will probably recognise these reactions from learners with developmental and attention deficits from e.g. the introverted child with ADD or the externalising child with ADHD.
The self of 1. Order	Here is the learner able to consider and interpret his directedness, and examines values and norms inside given settings. If the learner experience invincible frustration here, will he often start seeking for mirroring environments, which match the experience of offendedness. Teachers will probably recognise young people turning into e.g. gang environments (to experience a feeling of grandiosity) or into religious environments (to avoid a feeling of emptiness). For youth and young adults with ADHD this is well known reactions where e.g. younger men are at risk for turning into gangs and criminality (S. Dalsgaard, 2002).
The self of 2. Order	Here is the learner able to have a directedness on the directedness (meta-reflection), and examines values and norms inside settings by choice in order to realise his own ideals in this life-project. The process will be painful but often proceed successfully if the two previous phases are progressed positively. Teachers can support the learners at this level in learning activities addressing meta-reflection and introspection.

Table 6 The progression in the development of the self

3.3.3. POWERLESSNESS OR OMNIPOTENCE

A primary narcissism occurs in situations, where the self is hooked up between the two emotional conditions powerlessness and omnipotence. In the case of powerlessness, the learner experiences a feeling of being unable to do anything or being nothing, while the omnipotence offers an experience of grandiosity, where the learner feels he can do everything. In the case of powerlessness, does the learner need a protection by someone, who can do whatever has made him powerless as e.g. an empathic, understanding teacher. In the case of omnipotence wants the learner to do everything by himself and might be experienced as self-assertive.

These deviations between the feeling of powerlessness and omnipotence is a natural part of the development of a core-self, which in case of a beneficial and balanced process is getting so robust, it would be able to add and subtract in new challenges (Hermansen, 2005). On the other hand, if the necessary frustration over time is replaced by invincible frustration, occurs the narcissistic offendedness, which hinder a beneficial self-development through the three phases in table 6 above. The learner need object-relations at all levels and will waste away without them. The self can first be denoted as robust, when it is able to supply with a realistic assessment of its possibilities and the possibilities in the world.

3.3.4. RESONANCE AND CONFRONTATION

Subsequently, the challenge may be to establish situations where an ideal point of tension between mirroring and idealisation allows learning to happen (figure 4). If a learner meets such an optimal setting of mirroring and simultaneous has an extroverted willingness to his life project, he may get surplus to turn to object-relation environments. But a learner is deeply dependent on an emphatic, reflecting and understanding environment in the school, which in that sense may be understood as crucial for the whole initiative of inclusion.

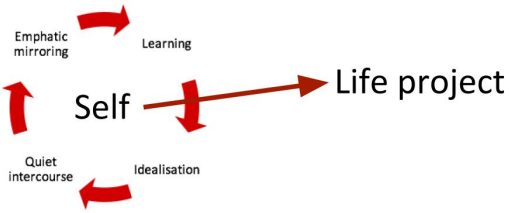


Figure 4 Ideal tension between mirroring and idealisation allows learning to happen

Following these thoughts of Kohut, teachers' resonance, understanding and responsiveness for a learner's reflection of his own situation is important for learning to occur. Resonance is here denoting that the learners' self-structure and directedness is understood. In other words – *recognising of the differences between students.* It may be helpful to evaluate the pedagogic designs and including interventions, and consider to which extent they are offering learners with developmental and attention deficits

- full resonance
- selective resonance
- dissonance, or
- lacking resonance.

But resonance is only the necessary basis and not in itself sufficient to proceed the development of the self. Learners need as well an 'explanation', understood as a confrontation, which bring up something new to the student's orientation field. When teachers are designing learning activities, they are providing students such confrontations, and it may be valuable to consider if the designed classroom activities are offering learners with developmental and attention difficulties

- constructive confrontation (helps the learner into the zone of proximal development (Vygotsky, 1978))
- destructive confrontation (obstruct someone to move into the zone of proximal development (ibid.), or
- lacking confrontation (avoidance, laziness, anti-social behaviour or a wish for cosiness).

Following this explanation of Kohut, the objective may be development of pedagogic designs with including interventions in an optimal frame for learning understood as necessary frustration, full resonance and constructive confrontation. Likewise, may support of teachers leave space for such evaluations and considerations. But as concluded by Ratner (2012), the task of inclusion is not done by reflexivity alone. The schools need as well to operationalise 'the optimal frame for learning' into real classroom practice, why the rest of this chapter deploys the thoughts of Dysthe (1997), Csikszentmihalyi (2014), Banduras (1997) and Freire (1970) in an attempt to concretise the object-relation theory of Kohut (1990) into classroom strategies.

3.3.5. RELATIONS, DIALOGUES AND EXPECTATIONS

The work of Dysthe (1997) suggest to focus on three essential factors in a learning environment:

- student-student/student-teacher relations
- dialogues in the classroom, and
- high expectations to the students.

Focussing on development of good student-student and student-teacher relations in a classroom setting leaves space for resonance, emphatic and understanding mirroring. When a learner is participating in dialogues in the classroom, he is provided opportunities for developing his self-image and identity in a balance of both connectedness and uniqueness. Constructive confrontation can be offered when teachers exhibit high expectations to the students through which idealising, goal-setting and utopia promoting mirroring also may occur. In other words, when teachers clearly are demonstrating for the learners what is worth striving for (and valuable) in life.

3.3.6. MOTIVATION AND FLOW

The balance between resonance and constructive confrontation may as well be recognised in Csikszentmihalyi's theory of flow (Csikszentmihalyi, 2014), in which the individual mental condition is experienced as the tension between objectives and options.

Csikszentmihalyi (2014) describe the normal basis condition in the mind as a 'mild gentle chaos', whereas a situation of flow induces intentions, feelings and thoughts to be experienced in harmony with each other. The learner's consciousness will be occupied by the activity and the experience itself – and he will meet omnipotence or flow in a condition of full attention and engagement with the activity (ibid.). The feeling of flow is according to Csikszentmihalyi in itself motivating (Csikszentmihalyi, 1997). The task is to ensure an appropriate balance between the learner's ability to do something and the challenge at hand, which according to the theory of flow (Csikszentmihalyi, 2014) leads to a feeling of satisfaction and inner motivation in a process.

Flow can be experienced in situations, where a task is both challenging and shaped to the focus learner's skills, while an unbalance between challenge and ability triggers anxiety, worry, apathy or boredom as illustrated in figure 5 (Andersen & Sorensen, 2017; Csikszentmihalyi, 2014).

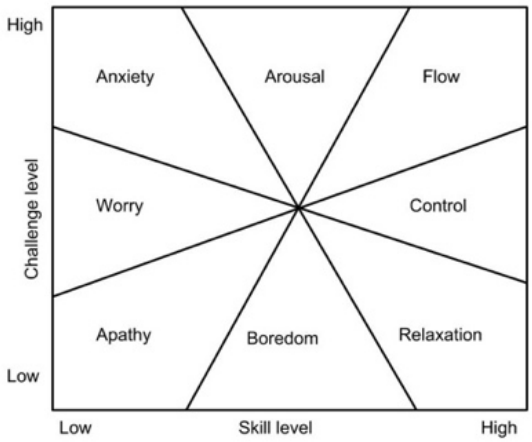


Figure 5 Flow illustrated as a harmonic balance between challenge and ability

In this understanding, the the most optimal learning environment can be characterised by the presence of many flow experiences (Lyhne & Knoop, 2008; Ørsted Andersen, 2012) as a vehicle for enabling maximal academic learning and

personal satisfaction or well-being. According to Csikszentmihalyi (2014), experiences of flow will strengthen the learner's self. Flow can be marked both as an effort on the edge of your capability and as a kind of 'letting go', where you are allowed to receive new insight, rediscover forgotten conditions of minds or memories, transcendent associations, visions on new horizons, creative problem solving or strengthening your identity (Csikszentmihalyi, 1997; 2014).

3.3.7. SELF-EFFICACY AND FLOW

A learner's directedness and approach to challenges in school might as well be dependent on his belief in his ability to succeed in the situation and accomplish with the task. This 'belief in one's own possibilities' is in the social cognitive theory of Banduras (1997) described as 'self-efficacy'. Like Kohut's mirroring/reflection (Kohut, 1990) is a learner's individual actions and reaction according to Bandura influenced of what he has observed by others. A learner with a high self-efficacy are more likely to see challenging task as something to be mastered, rather than something to be avoided (ibid.). When teachers meet learners with developmental and attention difficulties, these children may already be affected by previous experiences of not being 'like the others' or 'good enough'. In that case teachers, to succeed in changing these learners' behaviour, first of all may be considered in changing the learners' belief (Andersen & Sorensen, 2017; Andersen et al., 2017).

Changing focus learners' belief or increasing their self-efficacy is not a simple challenge for teachers, but explicitness on both earlier achievements (praising, feel pride), new expectations (encouraging, understand goal) and possible roads to follow (scaffolding, know how) may be helpful strategies. Schaffers' (2013) work concretise these strategies in his list for required conditions for getting into flow, which urge teachers, when designing learning activities, to consider if the learner:

1. Has high perceived skills
2. Knows what to do
3. Knows how to do it
4. Knows how well you are doing
5. Knows where to go (if navigation is involved)
6. Is free from distractions, and
7. Has high perceived challenges (ibid., p. 4).

3.3.8. EMPOWERMENT OF LEARNERS AND TEACHERS

Awareness on flow and self-efficacy is important but may only be considered as 'vehicles' for processes, where learners feel themselves able to manage tasks in the school in order to reach the real goal and feel themselves able to manage their life. Or with the words of Kohut (1990) – realising their life project. As 'humble helpers', the overall challenge to teachers could be understood as empowering (Freire, 1970)

all learners, but especially learners with special educational needs, to take the lead of their own life and learning without too much dependence on assistance or leadership from others. In order to fulfil the vision of inclusion in the Salamanca Declaration (UNESCO, 1994) and United Nations' humans rights to education (United Nations, 2006), the learners should not accept their difficulties as inevitable and belonging to the life itself. Neither should teachers, schools or parents. Trough processes of awareness, analysis, reflection and action (Freire, 1970) it may be possible to empower learners to be conscious about their situation, be able to assign meaning to it and taking steps toward changing the situation.

This chapter has described which challenges teachers may perceive as professionals in an including school in general and when including learners with developmental and attention difficulties in their teaching practice. In the last section is discussed how teachers can understand their role in the teacher/learner relation. Summing up may following concepts being considered of importance when developing innovative pedagogic design in contexts of inclusion:

- Building strong student-student/student-teacher relations
- Establish many dialogues in the classroom
- Provide constructive confrontations and exhibit high expectations to the learners
- Aim at enabling learners to work in flow
- Aim at developing learners' self-efficacy
- Empowering learners through processes of awareness, analysis, reflection and action.

As a final step, in order to develop a framework for investigation and development of innovative including technology-based interventions for learners with developmental and attention difficulties, the next chapter examines the potential of technologies for supporting this group of learners.

CHAPTER 4. THE POTENTIAL OF TECHNOLOGIES FOR SUPPORTING INCLUSION

To enable teachers to develop innovative pedagogic designs in contexts of including technology-based interventions, it is necessary to understand the potentials of technologies for supporting learning and inclusion. This chapter

1. Argue for using technologies to support inclusion
2. Discusses how technologies can be recognised as valuable for supporting inclusion
3. Present insight from research as inspiration for development of including technology-based interventions

Finally, the chapter presents a framework for this current study and a refined research question resting on the insights from chapters 2-4.

4.1. WHY USE TECHNOLOGIES TO SUPPORT INCLUSION?

In accordance with the Humans Rights of Persons with Disabilities (United Nations, 2006) states are obligated to "*promote the availability and use of* ***new technologies, including information and communications technologies, mobility aids, devices and assistive technologies****, suitable for persons with disabilities"* (ibid., Article 4).

States have to secure freedom of expression and opinion for all citizens and access to information by "*providing information intended for the general public to persons with disabilities in* ***accessible formats and technologies appropriate to different kinds of disabilities"*** (ibid., Article 21).

To ensure the right to education **"***government should facilitate learning of* ***Braille, alternative script, augmentative and alternative modes, means and formats of communication*** (ibid., Article 24) and ensure all persons' participation in public life "*government are required to facilitate the use of* ***assistive and new technologies*** (ibid., Article 29).

Consequently, it follows naturally that teachers must be considered as a main stakeholder for carrying out these obligations and allowing learners with special needs to be thoroughly versed in the possibilities of technologies.

Technologies have been recognised as a valuable tool for inclusion (Waller & Watkins, 2013; McKnight & Davies, 2012; WSIS, 2010) of people with disabilities in order to

- improve quality of life
- reduce social inclusion
- increase participation, and
- promote equity in educational opportunities

Furthermore, the potential of technologies in general educational contexts are widely recognised (e.g. Andersen et al., 2017; Conole et al., 2015; Hodgson, 2014; Dillenbourg et al., 1995; Dalsgaard & Sorensen, 2008; Brown & Davis, 2004; Dohn & Hansen, 2016; McKnight & Davies, 2012) for demonstrating impact regarding e.g.:

- providing support
- enhance student-centred learning approaches
- cognitive processing
- participation
- independent learning
- critical thinking
- creation, and
- collaboration in learning processes.

> "Unfortunately, people with learning disabilities generally still experience significant barriers to genuine social participation. ...[and] can be considered to be digitally excluded... IT can help with… bringing marginalised people back into their communities. However, there is still a distance to go before this goal can be achieved" (McKenzie, 2007 p. 21)

Since the amount of emerging technologies is enormous and the development seems infinite teachers and learners access to technologies are ongoing increasing. The field is generally marked by a great deal of hype and marketing rhetoric for 'brand new products and emerging possibilities' and unfortunately less focus on the real practical use (McKnight & Davies, 2012; Abbott, 2007b). Thus, it might be difficult for teachers to attain knowledge about and choose among the countless technologically options, why support and knowledge are requested.

4.2. HOW TO IDENTIFY TECHNOLOGIES TO SUPPORT INCLUSION?

From chapter 2.2 it was argued, that a learner could be understood as included, when he was able to participate and contribute academically and socially in the (physical or virtual) learning environment in a school.

A general used term for technologies to support inclusion and learning is Assistive Technologies (AT) (Abbott, 2007a; 2007b). Assistive Technologies can be defined as any item, piece of equipment or product system that is used to improve the

functionality of individuals and provide learners following benefits (Winther & O'Raw, 2010, p. 87):

- To get a greater control over their learning experiences (supporting academically inclusion)
- To participate in and contribute more fully in classroom activities and complete assignments independently (supporting physically, socially and academically inclusion)
- To interact to a greater extent with their typical peers, improving social skills and enhance acceptance (supporting socially inclusion)

Research documents (e.g. Abbott, 2007a; McKnight & Davies, 2012) that assistive technologies enable people, who experience learning difficulties, to live and learn effectively when using digital – rather than non-digital technologies (Abbott, 2007a). Furthermore, how use of assistive technologies provides equality, allows learners to learn at a speed suited their needs, minimize boundaries and improve creativity (McKnight & Davies, 2012).

A taxonomy, building on the role of the technologies in the assisting/including processes, is suggested (Abbott, 2007a; Abbott, 2007b):

- Technologies can be used to train and rehearse
- Technologies can be used to assist learning
- Technologies can be used to enable learning

4.2.1. TECHNOLOGIES TO TRAIN AND REHEARSE

Technologies to **train and rehearse** are very present in the marketplace, research literature and in the schools. They are mostly built on a behaviouristic model of learning, does not always provide a meaningful educational experience for those involved and showing limited educational validity (Abbott, 2007b). With the extensive penetration of iPads and Smartphones (since 2011), such applications have fostered a solid income stream for software developers and an often raised question by professionals and carers 'Do we have an app for that?' There seems to be more focus on the technology than on the way it is used (ibid.).

4.2.2. TECHNOLOGIES TO ASSIST LEARNING

Differently can technologies to **assist learning** be understood as technologies able to compensate for a disability or a difficulty in order to move towards a higher level of equality with other learners. The technology plays an important role, but it should be understood as more supporting than central in the learning process. The impact is related to the use of technology, not the specific type, as e.g. the impact is not caused the application PowerPoint, but the use of a presentation tool with

possibilities for many modalities. The prevalence of such assisting technologies are growing fast and increasingly built into mainstream generic digital applications, as e.g. Text-to-Speak and Speak-to-Text tools integrated in resources like Google Apps or in iPads and iPhones as a general tool (ibid.). This evolution from specific assistive technologies for individual learners to mainstream accessible technologies for all learners reduces the risk for stigmatisation and disadvantage (McKnight & Davies, 2012).

4.2.3. TECHNOLOGIES TO ENABLE LEARNING

Technologies to **enable learning** covers to some extent the same types of technologies as above, but now a more holistic understanding is present, where the learning gain is only possible in the intersection of technology, user and contextual practice. The use of the technology makes an essential improving difference which allows learning to happen (Abbott, 2007a). The other way around, learning will not be possible without this technology in the given context with a given learner. When looking from the perspective of a specific technology, an overlap between technologies to assist learning and technologies to enable learning might be discovered: A tool like e.g. Speak-to-Text might assist one learner to produce a text easier, but enable another student to write independently.

4.2.4. TECHNOLOGIES TO ENABLE ACCESS TO LEARNING

A forth category of assistive technologies has being proposed as technologies to **enable access to learning** (McKnight & Davies, 2012). Table 7 provides examples of technologies used to rehearse, assist, enable and enable access to learning.

Use of technologies to rehearse	Kokkalia and Drigas (2015) research finds that working memory can be improved by adaptive and extended training, while other researchers suggest use of games or novel software systems to support the improvement of focus learner's cognitive abilities consisting of increased concentration and inhibited impulsivity (Retalis et al., 2014), improved memory and attention (de la Guía, Lozano, & Penichet, 2015) and as a non-pharmaceutical alternative treatment of children with ADHD (Wegrzyn, Hearrington, Martin, & Randolph, 2012)
Use of technologies to assist learning	Technologies provide structure and information-rich multimedia content, which enhance individual attention. A significant improvement of accuracy of responses and on-task behaviour are recognised, when computers are used by learners with attention deficit disorders (ADD) (Winther & O'Raw, 2010; Shaw & Lewis, 2005). Multimedia-rich resources support learners with specific needs and provide a richer learning experience for all, while electronic visual

	scheduling systems support both organising and memory challenges (McKnight & Davies, 2012). Development of concepts can be improved by symbol supported learning, which has shown to increase the numbers of spontaneous questions asked by young people, enhance comprehension and help to make the understanding and use of concepts more permanent (Mavrou, 2012).
Use of technologies to enable learning	A great benefit of using communication devices for enable writing when using prediction, abbreviation or expansion is recognised (Garcia & Oliveira, 2008 in Waller & Watkins, 2013). The use of spell-checker, text-to-speech, planning tools are mentioned as specific valuable tools for training specific skills. Not using technologies is stated as a real barrier to the education of young people with specific language difficulties including dyslexia, dyscalculia and attention deficit disorders. (Couteret, 2009 in Waller & Watkins, 2013). Speech recognition technologies are emerging but recognised only as a part of the solution - not instead of but beside other training or development (Waller & Watkins, 2013). Collaborative learning is noticed when pairs of disabled and non-disabled learners in mainstream schools are working together on a computer using multimedia software and have a positive outcome of peer acceptance and interaction (Tan & Cheung, 2008).
Use of technologies to enable access to learning	Learning platforms and Virtual Learning Environments has allowed students to express themselves and interact with teachers and peers in non-verbal ways, and provides easily access to learning materials, learning activities and access to peer-support which has been reported to bridge the isolation (Jewitt, Hadjithoma-Garstka, Clark, Banaji, & Selwyn, 2010).

Table 7 Technologies for rehearsing, assisting, enabling and enabling access to learning

The taxonomy might be valuable when planning implementation of technologies. But to understand which technologies could be used for rehearsing, assisting or enabling learning to occur when it comes to learners with developmental and attention difficulties next section presents insight from research in this field.

4.3. HOW CAN TEACHERS BE ASSISTED BY RESEARCH?

From chapter 3.2 the following elements were recognised as recommendations when developing innovative pedagogic design for learners with developmental and attention difficulties: Provide predictability, increase productivity – as e.g. production of stories, support organisation, support memory, assist reading and writing, assist acquisition of knowledge – as e.g. understanding of stories, support self-regulation, assist homework, provide less large classroom settings and more small group work and work collaboratively on interventions as illustrated in figure 6.

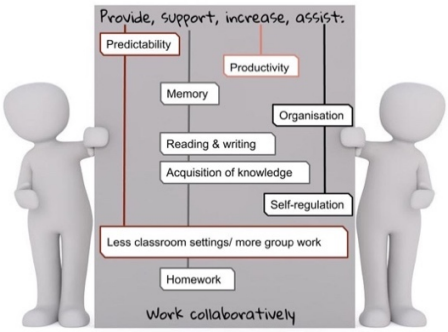


Figure 6 Recommendations for teachers when developing innovative pedagogic design for learners with developmental and attention difficulties

But which technologies may be valuable to utilise for supporting these elements in a real world setting in the including basic classroom? Which recommendations are to find in the research?

4.3.1. RESEARCH ON ASSISTIVE TECHNOLOGIES

Overall, the amount of European research in AT is very limited (Abbott, Brown, Evett, Standen, & Wright, 2011). Very few abstracts provides a holistic view of using technologies in inclusive education (Waller & Watkins, 2013, p. 8). Most research in technology, learning, and ASD is about remedial skills training. Rehearsing social skills is a key aspect in ASD – why there is a great deal of research into this area. Though, Farr (2010), points at Blogs as a promising field, which as well should be interesting for teachers:

> "Autistic users are sharing information and joining debates… For the first time individuals on the autistic spectrum have a voice in the debate and are able to express their view about what they like" (ibid.).

There is very little longitudinal, large-scale research into inclusion. The vast majority of existing research is small-scale and related to particular products (Andersen & Jensen, 2018). As the literature in AT in general is minimal, it obviously influences the research in assistive technologies for a specific group of learners with ADHD or ASD. Comparisons across geography, field, and time is difficult. Definitions and terms differs; ADHD is e.g. not always considered as a learning difficulty, but sometimes perceived purely as a behavioural problem (McKnight & Davies, 2012).

> "Perhaps because of this confusion about the classification of ADHD, there is little literature on technology approaches to supporting learners specifically with ADHD, although it is often addressed in literature on support for autism spectrum disorders due to the common comorbidity with this condition" (ibid. p. 36).

It seems evident that the use of technology is acceptable and motivating for this group of learners (Lindstedt and Umb-Carlsson, 2013; Parker and Banerjee, 2007), while solid evidence for improved learning outcome seems more flawed (Ploog, Scharf, Nelson, & Brooks, 2013). The ''dazzle'' of technology outstrips the clinical impetus and guidance toward true value and impact for the population and the individual (McCleery, 2015). The field is, though marked by a highly optimism based on initial, small-scale studies (Andersen & Jensen, 2018).

4.3.2. LEARNING DEVICES FOR LEARNERS WITH DEVELOPMENTAL AND ATTENTION DIFFICULTIES

Hardware as laptops, tablets, smartphones, and large multi-touch surfaces have been examined and accessed as valuable assistive technologies, which provide the learners with support at their fingertips or visual support in the classroom, while tangible technologies has shown to increase attention, participation and collaboration (McKnight and Davies, 2012).

The use of tablet devices has shown positive value and potential impact on teaching and learning for all learners (Waller & Watkins, 2013, p. 22; Flewitt, Messer, & Kucirkova, 2015). Clark & Luckin (2013 p. 3) find it evident that use of tablets enhanced the learning experience and transformed teaching practice, like teachers were enabled to promote independent learning and to differentiate learning more easily for different learners needs. Though, it may be fair to discuss if the positive results were caused 'the tablet', 'a personalised mobile device' or 'the resources' used on the tablet, as it was not clear.

It is well documented how mobile devices can be personalised and used in extended learning outside school settings (Naismith, Lonsdale, Vavoula, Sharples, & Series, 2004). Smartphones and tablets are a low cost solution and less stigmatising since the SEN learner is just like 'all the other guys'. The support is at their fingertips. Such

devices are seen as excellent tools for autistic people since they may reduce social isolation (Passey, 2010). The penetration of mobile devices as smartphones and tables has urged development of digital assistive technologies mediated through and built into these devices, which may result in easy access and increased familiarity for both learners and teachers.

Corn, Tagsold, & Argueta (2012) conclude that the use of laptops supports individualised learning with benefits in communication, organisation, confidence, reading ability, and assessments. The students with special educational needs in the study experienced themselves as capable as their peers in their reading, writing, and comprehension when using laptops for their learning (ibid.).

4.3.3. FROM ASSISTIVE TECHNOLOGY TO TECHNOLOGY-BASED INTERVENTION

Even though One-to-One computing seems to provide benefits for inclusive learning, the supporting pedagogy has still to fully develop. As concluded by Bocconi et al. (2013), it seems clear that simply equipping students and teachers with digital devices is not enough to bring about transformative changes to education. A shift from talking about 1:1 computing and instead focussing on 1:1 learning[4] is suggested (ibid.), which might foster a higher focus on the motivation and impact of using learning technologies. Bocconi et al. (2013) found

> "a knowledge gap about the deeper learning practices of students using their own digital devices or the links between hypothesised outcomes for 1:1 initiatives and different implementation measures, such as in-initial and in-service teacher training… [and found it] evident that there is a mismatch between the potential of technology to enable and facilitate innovative assessment practices that are an integral part of the learning process and the types of assessment, mainly summative, which are used in real settings" (ibid. p. 126).

Consequently, it seems necessary to observe not only the technology, but also the pedagogical frame into which the technologies are used. As this thesis uses the term

[4] *"The 'one-to-one' (1:1) learning initiatives in education refer to providing every teacher and student with a portable laptop, notebook or tablet PC for continuous use both in the classroom and at home… 1:1 indicates the ratio of devices to users, i.e. one netbook per learner. More recently however, the focus seems to have shifted away from the device to the learner and the acquisition of key competences with each student taking an active role based on the use of his/her personal device in a connected and well equipped classroom; hence the focus is on the notion of 1:1 learning rather than 1:1 devices…*" (Bocconi, Kampylis, & Punie, 2013)

'intervention' as an overall concept that encompasses the different kinds of solutions that are designed, which will include educational products, processes, programs, and policies (McKenney & Reeves, 2012), the term for using assistive technologies in such interventions would be 'technology-based interventions'.

4.3.4. TECHNOLOGY-BASED INTERVENTIONS FOR LEARNERS WITH DEVELOPMENTAL AND ATTENTION DIFFICULTIES

Following this idea when examining the field of research on assistive technologies for learners with developmental and attention difficulties in an educational setting seven categories of technology-based interventions are recognised (Andersen & Jensen, 2018), which may be of interest for design of innovative including interventions (figure 7):

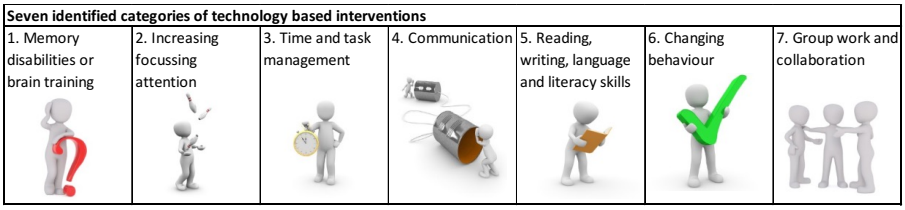


Figure 7 Identified technologies and technology-based interventions

Technologies are suggested to be particular effective for people with ASD as they may benefit from predictable and highly visual environments, clearly defined activities, reward structures, and possibilities for personalisation to a user's particular needs (ibid.; Hourcade, Bullock-Rest, & Hansen, 2012).

Technologies for keeping focus on task, rehearse appropriate behaviour, and support collaboration have shown to be promising for learners with ADHD (McKnight and Davies, 2012), where involving technologies seem to enable them to work more effectively and be more motivated for the learning activities. They work on more equal basis with tools they feel confident about and when sharing a genuine common interest with other participants.

Technologies have encouraged learners with attention difficulties to focus on tasks (Hribar, 2011) while Computer-Aided Instruction (CAI) is recommended as a tool to rehearse appropriate social behaviour for learners with ADHD (Fenstermacher, Olympia, & Sheridan, 2006) or to support collaboration and inclusion (Tan & Cheung, 2008; Tan & Cheung, 2006; Myllykoski & Paananen, 2009)

Teachers can use technologies as a diagnostic tool for **memory difficulties** or to rehearse and assist weak memory. Multimedia sources, digital games, tangible user interfaces (TUIs), and technologies which provide immediate feedback may enhance

the learner's pace in learning tasks, increase attention, inhibit impulsivity and improve memory.

Schools may be aware on background noises in classrooms, where Sound Field Amplification Systems (SFASs) has shown to be a valuable tool to improve learners' **focussing attention** and understanding, classroom behaviour, speech recognition, reading, writing, numeracy, and task completion. Similar positive impact may appear when using **time and task management** technologies, where a moderate gain in independent task completion are recognised. **Scheduling and organisation** have received a great deal of attention, as both people with ASD or ADHD are often challenged in memory, organisation, and handling events outside a fixed routine and might need help in transitions between different activities.

The review (Andersen & Jensen, 2018) find technologies with visual support important, when it comes to assist **communication**, save time for the staff, and enable learning to happen. Especially, the use of technologies has demonstrated to increase both qualitative and quantitative communication among students, specialists and carers. Perception, **literacy skills,** and performance seem to be supported well by using SFAS and multimodal materials, while gains in e.g. **reading skills** seem difficult to measure in the studies included. A systematic review identified 31 studies examining technology-aided intervention or instruction for adolescents with ASD (Odom et al., 2015). These studies address vocational skills, independent living skills, academics, social perception, social competence, and communication rehearsed or assisted through e.g. computer-based tasks and video modelling.

Visual structuring tools and video social stories may be considered as valuable opportunities for rehearsing or assisting **changing behaviour** in e.g. enhanced task engagement and completion, where learners are observed as acting calmer and showing more surplus of mental energy. Electronic visual scheduling systems are mentioned as being an invaluable support for young people with learning difficulties and ASD, where teachers are recommended to provide the timetable for the day both at the learner's individual devices and on a large screen display in the classroom. In the study is the large screen showing all learners timetables, which enable everybody to see what and how well peers are doing in a pedagogy where learners are encouraged to celebrate each other's progress.

Finally, gameplay technologies where clear-cut roles and rules are integrated in configurable and tangible user interfaces have shown to enable focus learners **group work and collaboration** if the student is motivated and engaged in the tasks. But, it is as well, concluded that teachers need to have carefully attention of the specific mechanisms of the gameplay if the intervention should reach the promising result of supporting social interaction of this group of users. Again, it seems to be an overall consideration when evaluating the efficacy of technology, that

> "the appropriate application of that technology in the instructional setting is a primary factor in its success and results should be judged in this context" (Chunzhen, Reid, & Steckelberg, 2002).

4.4. WHAT DOES THIS STUDY PROVIDE?

Even though benefits in these seven categories of technology-based interventions are identified and presented, it seems far from a simple solution to discover, choose, implement and develop the use of these technologies in the real world including classroom setting.

From chapter 3.3 the following concepts are being considered of importance when developing innovative pedagogic design for learning (figure 8):

Figure 8 Concepts of importance when developing innovative pedagogic design

- Building strong student-student/student-teacher relations, establishing many dialogues in the classroom (Dysthe, 2003)
- Providing constructive confrontations, and exhibiting high expectations to the learners' (Kohut, 1990)
- Enabling learners to work in flow (Csikszentmihalyi, 2014)
- Developing learners' self-efficacy (Bandura, 1997), and
- Empowering learners through processes of awareness, analysis, reflection and action (Freire, 1970).

Drawing a line from chapter 2 on inclusion, though chapter 3 on teachers' challenges when designing learning environments in general and specific for learners with developmental and attention difficulties until chapter 4 on the potential of technologies for supporting including learning processes for this group of learners may constitute a framework for the investigation (figure 9) and expanding the research question as follows:

How can teachers be supported to utilise the identified categories of technologies in their development of innovative pedagogic designs, where learners with developmental and attention difficulties are empowered to participate and contribute in an including learning environment experiencing flow and self-efficacy in constructive confrontations with teachers and peers?

The framework (figure 9) and the refined research question have infused the investigations in 26 classrooms that form the forum of this piece of research. The next chapter accounts for the methodology and the design behind the study.

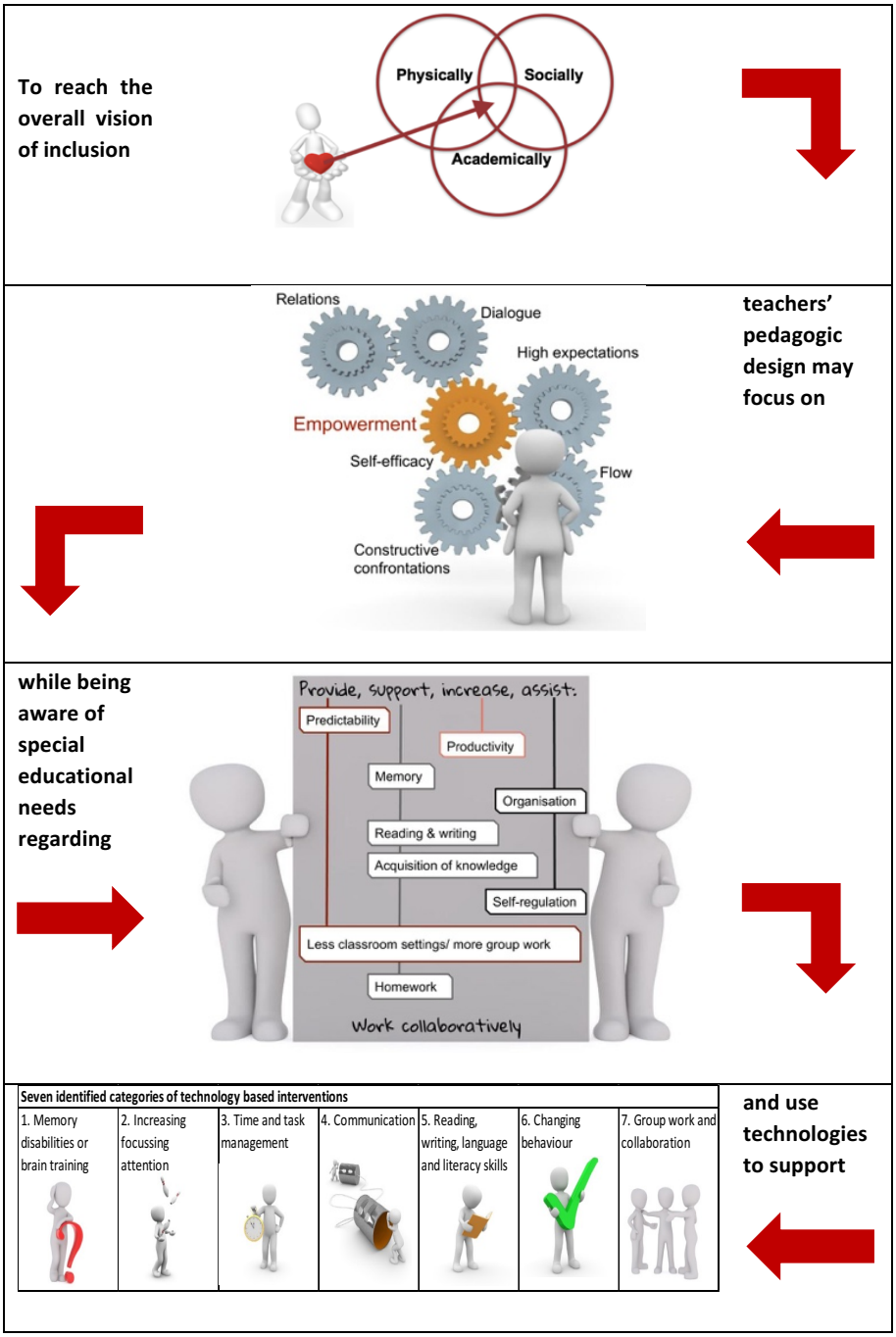


Figure 9 Framework for investigation of including technology-based interventions for learners with developmental and attention difficulties

CHAPTER 5. METHODOLOGY

To examine how teachers can develop their pedagogical practice and use new technologies to support a new group of learners is not an easy task.

> "Assistive Technology is a complex phenomenon that takes place in real life, involving technology, humans and activity, while taking place in different contexts... Given the complexity of the whole phenomenon, it is a significant challenge to decide on the correct [methodology]... It may even be that methodological compromises in the studies related to children and AT do not fulfil the criteria of those who fund research or review journal articles, and thus the whole research area becomes more marginalized than it deserves" (Salminen, 2008 p. 177).

As this thesis investigate processes, which were not invented and carried out from the beginning, the approach had to be open, explorative and facilitate interventions to occur. The research has been completely dependent on the practitioners' willingness to participate, contribute and sharing their thoughts and experiences during their development processes. Consequently, and true to the theoretical optic presented in chapter 3.3 on teacher/learner relation, the same approach has been applied in the research design.

The researcher may establish an including environment in the research project, where tasks and activities are providing the participants necessary frustrations without leaving them with invincible or narcissistic offendedness (Kohut, 1990; chapter 3.3). The participants may be challenged, but the challenges should trigger more omnipotence than powerlessness (ibid). The researcher may provide the teachers with tasks, where they through dialogs are meta-reflecting and generating a directedness on their own directedness, and thereby help them develop a robust (professional) self with awareness on both their own possibilities and the possibilities in the world. In other words, empower the teachers to know themselves as professionals – including their competencies and boundaries.

This chapter elucidates how the research behind the thesis is designed and falls in three parts:

1. The first section clarifies the approach for this final dissertation article
2. The second part contains the overall methodology, and
3. The third part presents the research design behind the ididakt project, during which the empirical materials are collected.

5.1. APPROACH FOR THIS DISSERTATION ARTICLE

While the published dissertation articles take their point of departure in technologies and focus learners' needs, this final thesis framework is reflecting the same work from the perspective of the teachers. The framework may be understood as a meta perspective study, where the individual papers are revisited, reflected and discussed from the perspective of today in correlation with

- The relevance of the problem
- The findings
- New perspectives
- Potential confirms/dismisses of the adequacy of the concepts
- Further theoretical developments

The methodology in this thesis is inspired by the thinking of Paul Ricoeur and the perspectives of hermeneutical phenomenology (Ricœur & Thompson, 2016; Ricoeur, 1973), where the investigations tries to capture the 'truth of life' as it occurs in the general classroom through learners' and teachers' experiences and researcher's observations and interpretations of events and phenomenon.

Riceour's combination of phenomenology with a critical hermeneutical philosophy allows a critical reflections and interpretation into which new realisation and understanding of the phenomenon may arise (Dreyer & Pedersen, 2010; Ricoeur, 1973). The final dissertation framework should be understood as a hermeneutical phenomenological interpretation of the dissertation articles, where they are used as sources for reflections, critical assessments and discussions on their findings and perspectives.

During the reflections may questions as:

- Which potentials and pitfalls has been exposed in the research?
- What may the findings mean to the teachers?
- How may teachers be supported by the conclusions?

may identify structural conditions or social interactions influencing the teachers' possibilities for using technology as a vehicle for supporting learners with develop and attention difficulties in the classroom activities. The reflection includes yet unpublished materials from the study and insights from other research.

5.2. OVERALL METHODOLOGY FOR THIS RESEARCH

This section accounts for the overall methodology which can be described as Educational Design Research (5.2.2), where Mixed Methods (5.2.3) are used to

facilitate participatory development processes (5.3.2) and collect empirical materials (5.3.4) which are analysed and presented through hermeneutic phenomenological interpretations (5.2.5).

5.2.1. EDUCATIONAL RESEARCH

As described by Berliner (2002), doing educational research is indeed not a simple task. He defines it as 'The Hardest Science of All' while querying the traditional distinction between natural science as hard and social science as soft saying:

> "Easy-to-do science is what those in physics, chemistry, geology, and some other fields do. Hard-to-do-science is what the social scientist do and, in particular, it is what we educational researchers do" (ibid.).

As educational researchers, we must deal with and tolerate problems and conditions (as e.g. the power of context, the ubiquity of interactions and the historically connectedness) which both seem very different from those faced by easy-to-do-sciences and limit the possibilities for generalisation and theory building.

This current piece of educational research, investigating emerging innovative pedagogical practices in real world settings, contains an enormous amount of uncontrollable factors, which make true randomized experiments nearly impossible. It is an endeavour with disturbances which may be difficult to predict and unable to avoid. But, it is also a travel with unexpected progress hard to imagine. Educational research is an artful craft (Greene, 2007), where researchers have to tolerate and welcome chaos, and find new solutions, when they hit the dead end. Even though it is described otherwise in most of the methodology books, retrospectively, it seems fair to conclude that "*serendipity often plays a role in the pathway* [such] *studies actually take*" (McKenney & Reeves, 2012, p. 3).

The research behind this thesis – in the ididakt project - had essentially a bottom up approach, where almost everything changed or evolved over time: the scope, the context, the participants, the co-researchers etc. What in the beginning of 2013 was thought as a straight and simple task on measuring the outcome of using technologies in schools with an including purpose, turned in to being a complicated and complex journey. The vehicle was build while it was running, many factors were impossible to move, while other factors where changing more than we had ever imagined. As a few but powerful examples of disturbances, KLs lockout of all Danish teachers in April 2013, the implementation of a new law on teachers working agreement in August 2013 (Beskæftigelsesministeriet, 2013) and implementation of an extensive school reform from August 2014 (Ministeriet for Børn, Undervisning og Ligestilling, 2015) could be mentioned. The research approach had to be open for these shifting conditions, but learning from experience, it would be fair to

acknowledge Berliner for his interpretation of Educational Research as a Hard-to-do-science (Berliner, 2002).

5.2.2. EDUCATIONAL DESIGN RESEARCH (EDR)

Given the fact, that the study, in order to answer the research questions, had to facilitate development processes before empirical investigations was enabled, the study is conducted as a mixed methods inquiry in the frame of Educational Design Research (EDR) (McKenney & Reeves, 2012). EDR is a

> "genre of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigations, which yield theoretical understanding that can inform the work of others" (ibid. p. 7).

EDR is not a fixed method. It is a genre, where multiple approaches can be combined considering the different initiating problems, research questions and contexts. EDR is characterised by portraying a process, which can be described as a complex and multi-faceted endeavour, but defined by being theoretical oriented, interventionistic, collaborative, responsively grounded and iterative (ibid).

Educational Design Research provides an opportunity to generate ecologically valid, relevant and robust knowledge, where methods, materials and settings for the study are closely related to real life situations (ibid.; Brewer, 2000). The aim of an EDR study is to generate usable knowledge for as well researchers as practitioners. Since Educational Design Research is conducted in real world settings and data is developed in the classrooms or other learning environments, the research design has to embrace a very complex system with many different participants, interactions, and influencing factors, where multiple methods and methodological creativity seem crucial to capture the complexity.

5.2.3. MIXED METHODS RESEARCH

As the field of investigations can both be categorised as complex and emerging, it was a natural following decision to chose a mixed methods research approach to capture the field from diverse perspectives. Mixing methods in the EDR framework makes it possible to collect and analyse various kinds of data, looking for patterns across different data sources, attempt to integrate the findings and draw inferences using both qualitative and quantitative approaches in the inquiry (Teddlie & Tashakkori, 2006 p. 15).

Furthermore, the Mixed Methods Research may be understood as a symbolic match to the objectives of this study – inclusion and equality - and the research lens, which welcome the idea of difference and diversity:

> "Engaging with diversity and difference in social inquiry is thus both a substantive and moral commitment. It is enacted in what issues we as inquirers address, what methods we use, what kinds of reports we craft – that is, where we locate our work in society – and in who we are as inquirers, where we position ourselves in our work, what kinds of relationships we forge with others, and what we attend to and what matters in those relationships. A mixed methods way of thinking, as enacted in a mixed methods approach to inquiry, offers considerable promise for conducting social inquiry that meaningfully engage with difference and that is thus positioned in service to the public good, toward a noble vision of a pluralistic society characterized not by radical disparities in power and privileged, but by tolerance, understanding and acceptance" (Greene, 2007, p. 29-30).

The level of mixing is an ongoing discussion among Mixed Methods researchers. Inspired by Greene (2007), this research seeks space for more than qualitative or quantitative traditions and calls for multiple different paradigms and methodological traditions. Greene (ibid.) emphasizes, as well, a strong link between intended purpose for mixing and the mixed methods design decisions, and states that methods are always implemented from within a particular assumptive framework, why self-conscious attention on this is needed and a disclosure of the researcher's lens is an imperative.

5.2.4. DISCLOSURE OF THE RESEARCHERS' LENS

> "A mental model is the set of assumptions, understandings, predispositions and values and beliefs with which all social inquirers approach their work. Mental models influence how we craft our work in terms of what we choose to study and how we frame, design and implement a given inquiry. Mental models also influence how we observe and listen, what we see and hear, what we interpret as salient and important, and indeed what we learn form our empirical work" (Greene, 2007, p. 12).

My mental model as a researcher is influenced by my commitment to a mixed methods way of thinking. As the realists, the existence of an objective external social world is accepted, but in an understanding of the interpretation of this social world as subjectively constructed, internal perspective based on personal beliefs and values. The history of today shows that the human attempt to understand the complex world through dichotomies, has brought us more problems than solutions. Likewise, in the academic world it could be said that dichotomies might have fostered more inertia than progression. The global, national, local, environmental, political, religious, and cultural challenges we meet in the 21st century necessitate (or maybe even dictate) that we do our very best and combine all possible

knowledge, engage with diversity and learn how to deal with, appreciate and accept differences.

There are multiple legitimate approaches, but they are all inevitably partial. A mixed methods way of thinking may be understood as a dialogic engagement with difference. It reflects an ideological stance, where ways of knowing and understanding are regarded as ways of valuing. This mental model would influence the entire research process – from creation of research questions, during the design choices, data gathering, and analysis processes to the very end in the conclusions, discussions, and presentations. The study is inspired by the metaphor for mixed methods inquiries as a coffee table (Greene, 2007, p. 13), where multiple mental models are invited to a respectful conversation for collaboratively learning and dialoguing in purposes of generating a better understanding of the phenomena being studied, why this metaphor may be acknowledged as descriptive for this study.

All mental models are influenced by substantive theory, disciplinary perspectives, philosophy of science, methodological traditions, education and training, contextual or practical factors and personal values (Greene, 2007) why mixing them might present conflicting characteristics, assumptions and beliefs. I do see these conflicts as generative, if they are meaningfully engaged through respectful dialogues, and appreciate this stance as an attempt to setting aside philosophical purity and its incommensurability and, instead, welcoming a diversity of philosophical stances in a dialogic form. The aim is, that such dialogues spawn new understanding

> "that is woven from strands of particularity and generality, contextual complexity and patterned regularity, inside and outside perspectives, the whole and its constituent parts, change and stability, equity and excellence and so forth. That is, [it] seeks not so much convergence as insight… the generation of important understandings and discernments through the juxtaposition of different lenses, perspectives and stances; in a good mixed methods study, difference is constitutive and fundamentally generative" (Greene, 2007, p. 79).

A dialectic stance such as this matches values of tolerance, acceptance, equity, and inclusion and may enable a meaningfully engagement of working for the public good in a democratic tradition. In that sense, it fits very well the overall aim of this inquiry.

The personal lens of the researcher is, also influenced by 20 years of experience as a teacher in public schools in Denmark, which, in advance, have provided familiarity with both the context and the topic. In this way privileged with a deep insight and understanding of the field (Nielsen & Repstad, 2006), but simultaneous aware of how such insights from a researcher's own backyard, as well may induce blind spots in the observations and perception of the field. Consequently, the study is conducted

in close collaboration with research colleagues and a focussed attention on the risk of going too fast after 'obvious solutions' or biased conclusions (ibid.).

As described above, there is no fixed receipt to follow, when conducting a mixed method study in the frame of Educational Design Research, but it should not be understood as anything goes. All though the study is mixing methods, theories and disciplines, the aim has been to handle them with respect to their different characteristics and underlying scientific philosophy.

5.2.5. HERMENEUTIC PHENOMENOLOGICAL APPROACH

The overall methodology in this thesis is inspired by the thinking of Paul Ricoeur and the perspectives of hermeneutical phenomenology (Ricœur & Thompson, 2016). The investigations have tried to capture the 'truth of life' as it occurs in the general classroom through learners' and teachers' experiences and researcher's observations and interpretations of events and phenomenon.

The phenomenology refers to Edmund Husserl, which philosophy attempts to go to 'the case itself' and sees the lifeworld as fundamental in the human reality (Schiermer, 2013). With the phenomenology it should be possible to let the phenomena speak for themselves without infusing with theory or hypothesis, which should produce open-minded/unprejudiced/unbiased descriptions of the reality as it turns out in our minds. The phenomenology may help us to reach the essence of a phenomenon (Egholm, 2014).

The lifeworld is our concrete reality, which we are able to experience; we take it for granted and seem to be familiar with it in our daily lives. This lifeworld, as it occurs in the classroom and in the minds of learners and teachers has been the basis of this study; going to 'the case it-self' and ask teachers how they are challenged in their professional lifeworld in the classroom and how they experience the challenges of learners with developmental and attention difficulties.

The hermeneutic refers to Gadamer, who state the hermeneutic to be an understanding generated of valid interpretations rather than a method (Egholm, 2014). Combined phenomenological hermeneutical research may be based on the meaning of lived experiences and tries to visualise this meaning from expressions in e.g. texts.

Ricoeur combines the hermeneutic paradigm with the phenomenological paradigm in a critical reflecting theory, where he states, that *'consciousness always is conscious for someone'*, and the interpretation is essential to derive new understanding and realisation (Trettin, 2012). The interpretation occurs as an infinite chain of new meaning or possibilities for action. According to Ricoeur's philosophy of

interpretation, is it not necessary to remove the author from the text. The focus is, instead, how the text displays the world to us (Ricœur & Thompson, 2016).

The interpretation can be understood as process, where the part and the whole are studied together. Ricoeur does not find any contradiction between understanding and explanation, but handle the concepts dialectically (Kemp, 1987). A text can only be indicative if it is acquired or becomes 'true for me'. The explanation of the meaning of a text must be a part of the understanding (ibid.).

According to Ricoeur, the distanced explanation contributes to the understanding (Ricoeur, 1973). By letting the text be objective, it is distanced and has its own story to tell. It is not about what is written in the text as what it is talking about. The text may be understood in the light of its content and not in the light of a specific author or context. In that sense, the distanciation is an integrated part of the interpretation. The interpretation is not equal to a structural analysis, but rather it consist of an interaction between distanciation, acquisition, affiliation and objectivism (Ricœur & Thompson, 2016). The critical aspect is the key in the interpretation for setting the meaning in front of the text. The aim is to explain and 'generalise' the local meaning in a single text to a common meaning of universal importance (Ricoeur, 1973).

Ricoeur states that there are more possible interpretations of a text, but one interpretation must be more plausible than others (Kemp, 1987). A hermeneutical phenomenological study should then be assessed after logic of probability instead of an empirical logic of verification (Hermansen & Rendtorff, 2002). But what does a hermeneutical phenomenological study then provide the research community? In sync with the call for a dialectic dialogue above, Ricoeur's hermeneutic phenomenology provides a significant contribution to a possible bridge between the natural science with its objective descriptions and distanciations and the human science with its understanding through engagement and empathy.

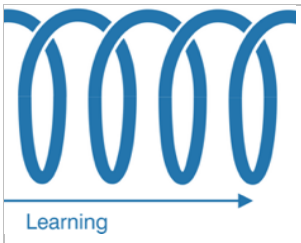
5.3. RESEARCH DESIGN

While this chapter so far accounts for the overall methodology, the final section outlines the research design behind the ididakt project, during which the empirical inquiry for this thesis is conducted.

5.3.1. RESEARCH CONTEXT

The Ph.D. study has been realised with means from SATS-funds (Ministeriet for Børn og Undervisning, 2012b) as a part of the ididakt project 2013-2016 (Andersen et al., 2017). The ididakt project was inspired from my master thesis from 2011, where an ICT-facilitated concept for inclusion of children with ADHD in schools was presented (Andersen & Grum, 2011). Ididakt investigates how different kinds of state-of-the-art technologies available in schools today may contribute to enhanced physical,

academical and social inclusion of learners with developmental and attentional difficulties in public schools' mainstream classes. The project produced many data and a number of research papers and reports. Some of them are included in this thesis. The author's insights are generated throughout the processes illustrated in figure 10:



Loop 1: Pre-conceptual design in Master thesis (2009-2012)

Loop 2: Ididakt Sandbox 1 – First iteration (2013-2014)

Loop 3: Ididakt Sandbox 2 – Second iteration (2014-2015)

Loop 4: Final analysis, evaluation and dissemination (2015-2016)

Loop 5: Reflecting past research in Ph.D. thesis (2017)

Figure 10 Iterations of investigation in the topic of research

The aim of both the ididakt study and this thesis is to elucidate potentials and pitfalls in teachers use of technology-based interventions as a vehicle for inclusion of learners with developmental and attention difficulties asking: What can be done? But most important, to inspire and provide practical solutions to professionals, who are dealing with inclusion challenges in their daily practices and, thereby, support them to develop better solutions for these children asking: Why and how to be done?

5.3.2. PARTICIPATORY ACTION RESEARCH PROCESSES

In order to follow the EDR approach and conduct a context for iterative development of solutions to the practical and complex inclusion problems as a context for empirical investigations, Participatory Action Research Processes was established. The study was inspired by the critical-utopian tradition (Jungk & Müllert, 1989; Duus, Husted, Kildedal, & Laursen, 2012), which allows researchers to participate as a professional dialogue partner in the transformation processes occurring at the schools and learn from the teachers experiences (Sagor, 2000).

The motivation behind the choice of Participatory Action Research (PAR) was the fact, that it allows researchers to be in close contact with the practitioners, enables analyses and experiments in the field and contributes with solutions to the objectives of the study (Brinkmann & Tanggaard, 2015). But the PAR was, as well, chosen in respect to the teachers' professionalism realising that they embrace a professional insight we were never able to capture without their participation.

Consequently, the teachers were involved as co-researchers. They were allowed to base their active participation and actions on their own perceptions of challenges in

their local contexts, as it may be a vehicle for enhanced understanding of the objectives, ownership and empowerment (Freire, 1970). The requirement to the researchers was to study the movements, but also initiate actions based on theoretical knowledge and understandings about inclusion, learning and technology in order to generate learning in the field (Duus et al., 2012, p. 83). The different roles and the tasks of participants and researchers are, inspired by Duus et al. (2012), clarified in table 8.

Level of effort	The participant's task: Develop practice	Shared tasks: Collaborate, plan and manage	The researcher's tasks: Running the business
Basis level	Deliver data Co-produce new knowledge Test new knowledge Transform knowledge into practice	Articulate problems and objectives Study learning processes Work out contradictions and conflicts Support the process	Collect data Analyse data Deliver new knowledge Support transformation of new knowledge
Meta level	Discuss appropriate ways to initiate learning processes	Analyse the organisation as a learning unit – create learning strategies	Give feedback on participants learning processes
End level	Develop and refine practice	Evaluate results, finish the collaboration between researcher and field	Develop local and eventual generalizable knowledge

Table 8 Researchers' and Participants' roles and deliveries in Participatory Action Research

5.3.3. EMPIRICAL INVESTIGATION PROCESSES

The researcher's task is, as described in table 8, to collect and analyse data and deliver new knowledge generated from the teachers' interventions[5] in the PAR

[5] Inspired by McKenney & Reeves (2012, p. 14), the term interventions are used as a concept for different kinds of solutions that are designed: "*Interventions can include educational products (e.g. learning materials), processes (e.g. teaching repertoires), programs (e.g. professional development scenarios) or politics (e.g. protocols for school evaluation*)

processes. Realising this, an integrated research design, where data can be tapped from many different perspectives, was constructed into which observations, experiences and descriptions from both teachers, focus learners, peers, school leaders and researchers are collected. Different methods were implemented both concurrently and sequentially. Qualitative and quantitative data was collected, analysed and used both independently and interactively in the research processes in order to:

- Map the challenges by the focus learners before and after the interventions
- Map the teachers' challenges in including classroom practices
- Map the used technologies and the interventions in which technologies were used
- Map the learners' perspectives on inclusion and their use of technologies
- Assess and evaluate the impact of the interventions on the focus learners
- Assess and evaluate the impact of the interventions on the teachers practice
- Identify potentials and challenges by implementing and using technologies in the schools
- Assess the value of the research/development program

The integrated research design offered varied and differentiated design possibilities, but, definitely, also interaction challenges in the analysis (Greene, 2007, p. 125). The concurrent participatory action research processes and the empirical investigation processes are illustrated in figure 11 (Andersen & Sorensen, 2016; Andersen et al., 2017).

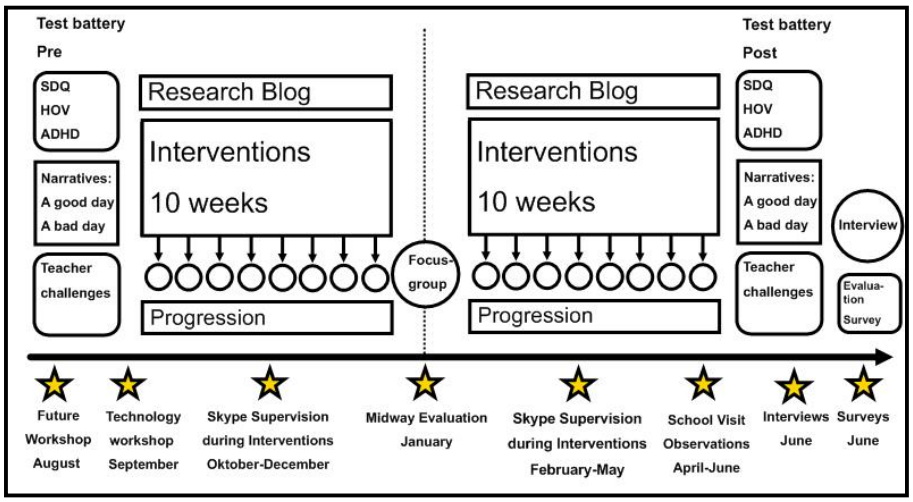


Figure 11 The research design for one of the two uniform iterations in the ididakt study

5.3.4. DATA COLLECTION PROCESSES

The PAR process was scheduled to last a year and was running in two iterations with different schools in each iteration. The aim of this construction was to develop solutions in the first year in one context (Sandbox 1) and test or refine them in another context the second year (Sandbox 2). The two iterations were mainly identical. The data-collection methods are illustrated briefly in table 9.

Method	**Aim**
Pre-post test battery	Quantitative data on focus learners' challenges in classroom activities before and after use of technology-based interventions may be used to describe the impact of the ididakt intervention program.
Pre-post test battery	Qualitative data on focus learners' challenges may be used to inform the researchers and improve their recommendations when supporting practitioners.
Future workshop – teacher challenges	Qualitative data is generated and to some extent quantified and analysed during the workshop collaboratively with the participants (voting and arguing) by which teachers' challenges are identified
Evaluation survey – teachers challenges	Qualitative and quantitative data are collected in a final survey referring to the identified challenges in the future workshop
Research blog	Qualitative data are collected in a shared research blog, where teachers in written language describe their interventions and the focus learners' reactions. Researchers have commented and facilitated the dialogue.
Field notes from seminars, school visits, skype supervision etc.	Qualitative data which elaborate and clarify the understandings from surveys or blog entries. At these meetings teachers are encouraged to express their experiences from the intervention processes in spoken language.
Surveys, interview and written narratives	Three different approaches have been used to capture the learners' voices and learn about their perspectives in the inclusion processes and their experiences of the technology-based interventions.

Observations	Qualitative data on teachers' and focus learners' advantages and challenges in the classroom activities when using technology

Table 9 The methods and the generated data in ididakt

5.3.5. DATA ANALYSIS PROCESSES

The qualitative data from the Pre-Post test has been analysed separately and independently by one of the co-researchers who did not participate in the PAR. The responses evaluate if the focus learners met the inclusion requirements (having attention and developmental difficulties). A descriptive statistic was presented as an average for the whole group before and after the technology-based interventions has been introduced and for the percentage of focus learners with a score in respectively normal, borderline or high level. Statistically comparisons of the groups score before and after the introduction of technology-based interventions were calculated using independent and repeated measures t-test with a significance level on 5 % and by using the statistic SPSS program version 19 (Andersen et al., 2017).

The findings from the quantitative dataset (ibid. p. 113-141) have been used as a resonance for analysis processes and informed the work on the mixed set of qualitative data. Data on each focus learner's specific challenges and needs from the quantitative test battery have e.g. been used to inform the researcher and provide a more appropriate and focused support to the teachers involved.

The qualitative data have been used in integrated analysis from different perspectives in an overall phenomenological hermeneutic interpretation inspired by Ricoeur's hermeneutical function of distanciation, where the text becomes more 'objective' and 'have its own life' when it is being removed from the original authors intentions, meaning, or significance (Ricoeur, 1973; Ricoeur & Thompson, 2016; Dreyer & Pedersen, 2010). In Ricoeur's understanding, the use of poetic narratives to derive a distance in the interpretation of qualitative data may qualify the interpretation by enabling a transformation from the authors intentions towards a deeper understanding of the referring objectives in the text (Dreyer & Pedersen, 2010). This analytic approach allows researchers to create narratives across data in an analytic process implemented in four sequentially phases:

1. Converting speech into writing
2. Rewrite the text to a structured work – as a narrative
3. During this work deduce a kind of being-in-the-world related to data
4. Write and read the new structured work to reach a new level of understanding

Iterative loops of interpretation have been running along with the two years of interventions in the PAR processes and as a more distanced and structured interpretation after this period at three levels: naïve reading, structured analysis and critical analysis and discussion.

The naïve reading went through the whole data set several times from the very beginning of the project. The first task was to 'paint a picture' on each focus learner, and for that purpose data on each focus learner was structured and interpreted in a way that created a persona. The persona was important to enhance an understanding of each specific focus learner for supporting, discussing and evaluating the interventions with the teachers. The personas were conducted from the pre-test battery and further developed as long as new data on each learner occurred.

Secondly data on technologies were structured, and advantages, and challenges when using them in classroom activities were noticed in order to use, test, or refine positive experiences from one context as inspiration in other contexts.

Thirdly, data on teachers' advantages and challenges when implementing technology-based including interventions were collected and structured in order to facilitate the processes by providing possible solutions or to understand challenges in the organisational settings.

These three sets of data were growing during the investigations. A midway evaluation between Sandbox 1 and 2 compared the qualitative data with quantitative from Sandbox 1 in a preliminary integrated analysis. This analysis identified patterns for a preliminary typology of five overall purposes for technology-based including interventions (Andersen & Sorensen, 2017a), which were used as a framework for the interventions in Sandbox 2.

Afterward, this typology has been used as well as an optic for further analysis, where data from both sandboxes were integrated in order to strengthen and discuss the findings in interaction with the trans-disciplinary theoretical perspectives on inclusion, special education, learning, personal development, and assistive technologies. The five elements of the typology are illustrated in figure 12.

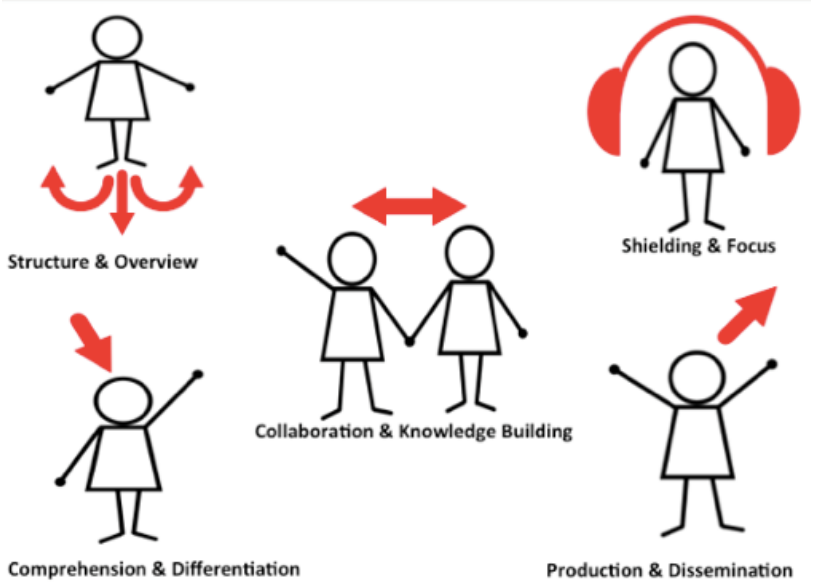


Figure 12 Preliminary typology of five purposes for technology-based including interventions

This process generated a structured study with five papers primarily from a technology/learner perspective (Andersen & Sorensen 2017b; Andersen, 2015; Andersen & Sorensen, 2017c; Sorensen & Andersen, 2017a; Sorensen & Andersen, 2017b), two papers primarily from a teacher perspective (Sorensen & Andersen, 2017c; Andersen & Sorensen, 2016) and a summarising report (Andersen et al., 2017), but left the field with many open questions in a perspective of focus learners and teachers.

Therefore, returning to the 56 personas and inspired by Ricoeur (Ricoeur, 1973; Ricoeur & Thompson, 2016; Dreyer & Pedersen, 2010), the texts now was structured across the data set into five different types or characters of focus learners in a mainstream public school classroom.

It was indeed and artful task, but a reduction of the complexity and the diversity into a framework was needed in order to unwrap the patterns. Afterwards, these five new fictive personas (Nielsen, 2013) were used as an analytical optic in a new process, where interventions, citations, examples of advantages and challenges was collected into a scenario (ibid.) trying to capture the very essence of the investigations. These five fictive personas are presented at http://ididakt.dk/cases/ as a framework for communicating the findings from the ididakt project to practitioner and inspire them to work with technology-based interventions in their including practice. The perspective of teachers may finally be reflected in this thesis.

5.3.6. VULNERABLE INDIVIDUALS

When investigating inclusion of learners with developmental and attention difficulties it is necessary to be aware of a range of ethical concerns and guarantee an appropriate protection against harm, confidentiality and anonymity.

The focus learners themselves are children – with difficulties or deficits they might not know about themselves. In some cases, they are diagnosed before the investigation – in others cases they are diagnosed during our research – and some of them will not be diagnosed at all. Researchers cannot go into the classroom and tell these children, if they have any difficulties. It is either not researchers mission to inform parents if their children should have deficits or difficulties according to the phenomenon investigated. Consequently, was decided to inform all parents of plus 500 learners in the 26 classes about the research project and ask all of them for permission and signed consent to their children's participation in the data collection and intervention processes in the classrooms.

Participation in the research project was accepted by the heads of the school departments in three municipalities. Afterwards, principals at 11 schools decided to enrol some of their classes due to the fact that they had a high number of challenged children with varying kinds of developmental and attention difficulties. The teachers, on the contrary, were not necessarily enrolled voluntarily. Some of them were, as they have specifically asked for being a part of the project. Others have been told to participate. An informed consent to use their impressions and experiences as data in the project was obtained.

When interviewing learners, both focus learners and peers have participated. First of all, to learn from their different perspectives in the inclusion processes, but also to cover the focus learners and protect them from being exposed as 'inclusion-children'. In a similar way, considerations were taking when special technological equipment was provided in the classroom setting (e.g. Sound Field Amplification Systems), given that all learners were allowed to try out the equipment – and both focus learners and peers could afterwards decide, if they wanted to proceed.

The data has been anonymized; the schools were renamed by letters and children and teachers by numbers. When cited in presentations the children are mentioned with sex and grade, while the teachers are mentioned as 'teacher at school x'. The teachers involved might recognise their own statements and pupils, but photos and videos from the dataset are not used in the dissemination to avoid any harm of the learners, teachers or schools. It is, on the other hand, frustrating not to include this material, since they contain and communicate very clearly what is at play in many situations. However, it would be unethical to run the risk of causing unnecessary exposure.

Observations in the classroom have provided insights into multiple perspectives on the actual situation in schools and classes – including situations not directly addressed in the field of investigation, but possible influencing factors. It has not been possible to use all these insights, as our protection of participants against any harm also includes schools and teachers, who have welcomed researchers in their classrooms and provided them with access to their professional practice.

5.3.7. CRITIQUE OF THIS METHOD

This field of educational research is very complex and filled with infinite uncertainties. We cannot find two identical contexts, learners or teachers. They are all having very different experiences and challenges when it comes to learning, inclusion, pedagogy, and technology.

The study is investigating development processes in a development process, and it can be hard to decide what is caused by the use of technology, by the pedagogical approach or other factors impossible to isolate or identify. Though, by choosing a multi perspective research approach, it is attempted to capture a thick description of the field and the development movements.

The individual methods have turned out with both strength and weaknesses. The quantitative data provided both a picture on the individual learner's challenges and development during the interventions, like they uncovered areas of movements in general across the different cases. But they did not leave any insight on what has happened in the classroom, and it was impossible to determine if the changes were caused by the learner's use of technologies or the teacher's use of new pedagogical approaches. The various range of qualitative data were, on the other hand, useful for learning about the classroom interventions and both teachers' and learners' experiences during the period of investigations. Though, these data turned out as well with individual pros and cons.

5.3.7.1 Capturing the teachers' voices

Teacher experiences are captured in blog entries, in F2F meetings, Skype-supervision and small surveys. In the written reflections in the research blog the teachers have freedom to present whatever they find interesting from their practice with inclusion and technology. Some of them are very open and write about their personal struggles. Some of them are writing as a team in relation to oral reflections at team meetings. Some of them are only writing because they have to – or try to avoid to do so. It may be a barrier for some of them to write about their professional challenges in this semi-public virtual space and share their experiences with colleagues from other schools. It can be hard to tell, if they have made mistakes or do not have sufficient competences on e.g. using technologies or linguistic skills. They may feel fear of being exposed. On the other hand, some of them may have a

wish to be promoted as a 'good teacher' with a risk for embellishing the reality. But the mayor concerns about collecting data from both written and oral reflections are the perspective of time. In their daily practice it is difficult for the teachers to find time and space for written reflections among many other – and often much more crucial – tasks. At seminars and meetings, it may be difficult to make oneself heard and they may have a need for protecting themselves, their colleagues or school.

5.3.7.2 Capturing the learners' voices

Learners' experiences are captured in written tasks, semi-structured or ad hoc interviews, and small surveys. All in all, it is a very time consuming and difficult task to gather data on children's experiences. It is difficult to use the same survey and the same language to children at age 6-16; either some of them do not understand the questions or they find them childish. When writing individual, some of them need help from teachers or parents – with a risk for influencing. When doing interviews, they often feel uncomfortable and show a desire for finishing and being released. Some of them are very frank and openly tell about their experiences – others are aware of the situation and try to give the interviewee 'the right' answer. The same conditions were noticed in classroom observations, where some of them felt free to speak while others seem to be embarrassed and afraid of being exposed. But in general, they demonstrated both curiosity and joy when dialoguing under classroom observations.

5.3.7.3 Open or fixed intervention program

In respect for the local possibilities, challenges and learners, the teachers were designing individual interventions. It generated different interventions and different data-set. A fixed program may have generated more equal data, but it may as well have provided the teachers and learners with meaningless interventions, which most likely would not have provided us with a better insight.

The open, explorative approach made it difficult to manage the processes in the classroom. The study was dependent on the teachers' inclination, willingness, and possibilities to participate and contribute. The researchers may have chosen to carry out the interventions in the classroom themselves, but such approach would not have generated knowledge teachers' problem solving processes and would not have had the same opportunities for learning though experiences, internal discussions and meta reflections.

5.3.7.4 Pushing development or tapping data

A lot of energy has been used to initiate and facilitate the development processes to occur before data collect was feasible. In the effort to make data as robust as possible, it was considered as important to let the teachers work on their own, but

retrospectively evaluated, it may have been rewarding to spend more time in the field and having more continuous dialogues with the teachers directly related to the classroom observations and experiences. It is the art of the possible. Following teachers in full time observations is very time consuming. Observations were carried out for five weeks in the field following five different teams, which generated very much data. Only little of it was directly related to the use of including technology, while the rest contains insight into influencing factors indirectly connected to the issue of research as e.g. working conditions, concurrent tasks, learning environment etc. or insight of no value for this study.

5.3.7.5 Number of cases and perspectives of time

More observation may have entailed less cases with a deeper insight but on the other hand, as well a limited spectrum of contexts, learners, teachers, and technologies. It could be argued that the research design is stretched between different desires – from a requirement of a certain volume in the research call to a need for participatory research processes to foster a context for study. As it was a demanding endeavour to initiate these processes and develop a shared language and routine, retrospectively, it would have been preferable to to work with all the schools in one long iteration for two years instead of shifting schools between Sandbox 1 and 2. It may as well have fostered more longitudinal results.

5.3.7.6 Mixed methods schizophrenia

It has been valuable to collect data from various perspectives using mixed methods to reveal what is at play in the classroom when using technologies in contexts of inclusion of learners with developmental and attention difficulties. Originally, it was expected that a structured triangulation could be carried out to provide strong evident claims based on convergence, consistency, corroboration, divergence or dissonance (Greene, 2007). But the explorative design and the various contexts (including learners' different needs and ages, teachers' competencies, kinds of technologies etc.) did not generate sufficient homogeneous data to follow this idea. Instead of a strong evident claim, the results must be considered as possible explanations, fostered and confirmed across many contexts and participants and seen from another perspective these factors make the results robust. 46 practitioners, 56 focus learners in 26 classrooms at 11 different schools have collaborated with researchers on examining, analysing, interpreting, explaining, and contribution with their view on the case. The strength of the study is this coffee table dialogue, where patterns are recognised and confirmed collaboratively.

5.3.8. RELIABILITY AND VALIDITY

The study has primarily used the teachers as lenses for the collection of data and may be criticised for relying too much on their assessment of the learners and their

descriptions of interventions and evaluations. Even if eventual 'blind angles' must be acknowledged, when teachers are observing and evaluating their own practice, it is difficult to get round the fact that they know the learners much better and recognise reactions by the learners which may be impossible for an external researcher to observe.

On the other hand, the teachers have primarily collaborated in teams when developing and implementing their technology-based interventions. They have discussed both interventions and evaluations with each other and published their assessments in a shared research blog. Their statements are combined with data from individual interviews, surveys, group interview and classroom observations, and given a high agreement between the different data sources the findings are considered as reliable.

The findings may as well be considered as robust in an applied perspective, given that data is collected in a real world teaching practice in collaboration with 46 teachers doing interventions in 26 classrooms. The technology-based interventions are primarily based on state-of-the-art technologies accessible in most schools which further strengthening the robustness and the transferability to other contexts. The interventions have demonstrated their impact as they have been tried out on 56 focus learners working together with peers in a basic classroom and not developed in an isolated laboratory practice. Due to the patterns recognised across these many contexts, individuals and situations, the study is considered as valid.

Certain reservations need to be taken when it come to reliability in educational research settings. Even though the interventions have demonstrated an impact (or not) in the investigated cases, the same results could not necessarily be found in other contexts. Playing the role as the devil's advocate, it may be claimed, that a control group had improved the strength of the findings. I do not agree. From my ontological point of view, golden standards of evidence cannot be generated in this field of research by control groups, as it is not possible to establish homogeneous groups with identical contexts and controllable conditions regarding pupils combination, challenges, teachers, age, subjects and technological possibilities. Furthermore, too many variables related to the individual focus learner are impossible to isolate as illustrated in figure 13.

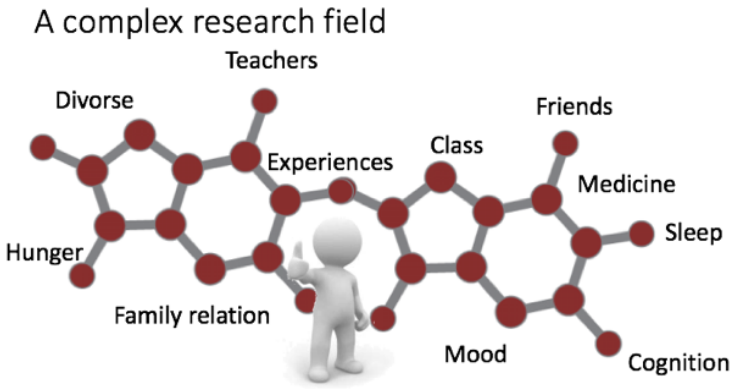


Figure 13 Examples of variables it was impossible to isolate in the study

Instead, the reliability may be assessed on the fact, that patterns are recognised across the different cases and between the iterations in Sandbox 1 and Sandbox 2. Sandbox 1 and Sandbox 2 delivered e.g. overall identical findings in the qualitative and quantitative studies. While the quantitative study shows in which areas the teachers observe differences before and after intervention in the focus learners' participation and contribution in the classroom, the qualitative study is telling the story of what actually happened in the classroom. Unified, the two years of investigation and the different kinds of data have provided what is called a 'robust' study with 'robust' knowledge (McKenney & Reeves, 2012) on why and how technology-based including interventions may be implemented.

The findings in this study is based on the experiences from teachers and focus learners at eleven schools in three municipalities reporting what works for them in an including classroom setting. It may be assumed, that the findings would work well for other students in similar educational settings. Taking the robustness in account, the complete study may be considered as valid and able to provide recommendations on how teachers can work with technologies in an including perspective for this specific group of learners.

PART 2 REFLECTIONS ON PAST RESEARCH

CHAPTER 6. REFLECTIONS ON PAST RESEARCH

The study of ididakt investigates how technologies can be utilised as supporting tools for learners with developmental and attention difficulties in including learning contexts. The findings are presented in a series of research articles, which may be useful as inspiration for development of a toolbox for technology-based including pedagogical practices. Chapter 6 reflects a part of this work from the perspective of teachers in order to understand how they can be enabled to realise insights from this research into their teaching practices.

The thesis is based on seven individual research papers written 2014-2017. Five of them are published in journals (EAI & EURODL), one is handed in for peer review regarding a book publication (Springer) while one is presented and published in a conference proceeding (EDEN).

1. "Assistive learning technologies for learners with ADHD and ASD – A review 2006-2016" (Andersen & Jensen, 2018)

2. "Technology as a vehicle for inclusion of learners with attention deficits in mainstream schools" (Andersen & Sorensen, 2017a)[6]

3. "Inducing omnipotence or powerlessness in learners with developmental and attention difficulties through structuring technologies" (Andersen & Sorensen, 2017b)

4. "Supporting inclusion of children with attention deficit-hyperactivity disorder using sound-field-amplification-systems" (Andersen, 2015)

5. "Enhancing understanding, flow and self-efficacy in learners with developmental and attention difficulties through ICT-based interventions" (Andersen & Sorensen, 2017c)

6. "Strengthening inclusion of learners with attention difficulties through interventions with digital technology in processes of production" (Sorensen & Andersen, 2017a)

[6] Awarded in two categories at *the European Distance and E-Learning Network 2015 Annual Conference Barcelona, 9-12, June, 2015* for Best Research Paper and Best Practice Paper among 276 papers.

7. ”Solitude or co-existence – or learning-together-apart with digital dialogic technologies for kids with developmental and attention difficulties” (Sorensen & Andersen, 2017b)

The first paper forms a state-of-the-art on assistive technologies for learners with ADHD or ADD from 2006-2016 (Andersen & Jensen, 2018) and is already presented in chapter 4. It is developed concurrently with the study and has been used to inform both the research and the supervision of the teachers during the PAR-processes with knowledge on technology. The second paper is written on the basis of preliminary analysis of data after first iteration in Sandbox 1. It identifies five themes of technology-based interventions presented as a explorative model for how to use technology as a vehicle for inclusion of learners with developmental and attention difficulties (Andersen & Sorensen, 2017). The following five papers investigates these five themes individually.

Chapter 6 is a revisited walk through past research, which from different perspectives supplies with potential answers to the question of research.

1. A brief presentation of conclusions from the dissertation articles is gathered into a comprehensive model for how technology may be able to support inclusion of learners with developmental and attention difficulties by means of ‘technology-based including interventions’. This model visualises the pupils as learners.
2. A reflection from the perspective of today looks ‘through’ these studies in order to identify, discuss, and describe necessities, constraints, and challenges when teachers employ such technology-based including interventions. The reflection develops and launches a potential framework for support of teachers in these processes. This model visualises teachers as learners.

The revision is inspired by Skovsmose & Borba (2004), who developed a framework for doing critical educational research or development of educational practices. The reflection uses the dissertation articles as data but includes as well unpublished materials and insights from other research.

It is not to be understood as a one-to-one relation between data and conclusions, but rather as a resonance, where the researcher involves a deep insight from the field of investigation to explore what may be lacking, disturbing, or constraining teachers in realising the identified potentials. The reflection goes behind data and may through discussion and interpretations of findings then distil an understanding of alternative solutions to experienced practice.

The framework of Skovsmose and Borba (ibid.) is illustrated in figure 14. It describes how development of educational practice with a current situation as the point of

departure aiming at making improvements towards a new imagined situation. Changes may then occur by organising new arranged situations. The model illustrates as well how the processes of pedagogical imagination, practical orientation, and critical reasoning can be understood as drivers for these developmental processes.

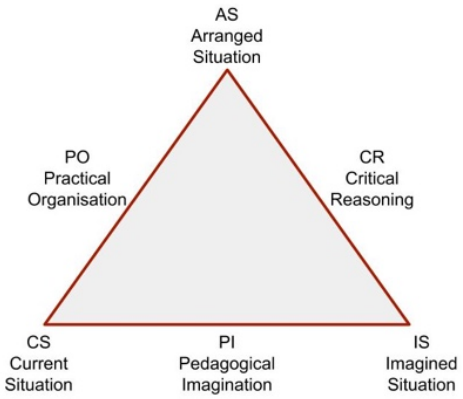


Figure 14 Framework for critical educational research or development of educational practices

The framework is considered as a fruitful lens for a reflection from the perspective of today. It symbolises to a high extent the research conducted and provides valuable concepts for examining:

How teachers can be supported in their teaching practices in developing innovative pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties?

6.1. MAKING THE KNOWLEDGE VISIBLE

Assistive learning technologies for learners with ADHD and ASD – A review 2006-2016

"This literature review is a part of a research project with focus on technology for supporting children with developmental and attention deficit to be included in mainstream school contexts (ididakt). The review contains research within the field of assistive learning technologies for learners with Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) in the period of 2006 to

	2016. The review is done, by using systematic and qualitative academically acknowledged literature search methods (n = 69). Seven categories are found as headlines for how and where the research is currently focused within technology-based interventions for (1) memory disabilities and/or brain training, (2) increasing focusing attention, (3) time and task management, (4) communication, (5) reading, writing, language and literacy skills, (6) changing behaviour and (7) group work and collaboration. The results indicate that the overall findings of the rendered studies present mixed conclusions. The review calls for more research in a mainstream school context with a universal design for learning approach" (Abstract in Andersen & Jensen, 2018).

When teachers in a current teaching situation meet children with developmental and attention difficulties, they may envision a new situation, where these children are well included in the classroom activities. Considering different tools to support these learners they may look at the amount of technologies accessible in the school and wonder 'what will work?' How to choose among all the different possibilities and the technologies usable for different kinds of tasks? Secondly, they might look for support in pedagogical or research literature after knowledge on 'what works'. Unfortunately, the field is not well described (Emtoft, 2017) why a State-of-The-Art literature review on assistive learning technologies for learners with ADHD and ASD from 2006 to 2016 is carried out (Andersen & Jensen, 2018).

The paper is based on a systematic search which prompts over thousand articles, but most of them are physiological or medication studies on ADHD/ASD with no relevance for the review. 69 articles are assessed as partly useful; only 36 of them about technology for the target group. Most research is carried out as studies in laboratorial settings, treatment settings or related to development of new technologies (n= 32). Among the 21 studies in educational settings only 15 are conducted in mainstream classrooms; some of them about technology targeted learners with ADHD, ASD or both – and with various focus on different types of challenges. All in all, the review does not provide a clear answer to the teachers' questions. Due to the small numbers of studies in basic school settings, studies at SEN schools, technology development studies and research with technology-based interventions in treatment and laboratory setting are included to inform broadly on possible solutions. From this work, seven categories of technology-based interventions are identified as illustrated in figure 15.

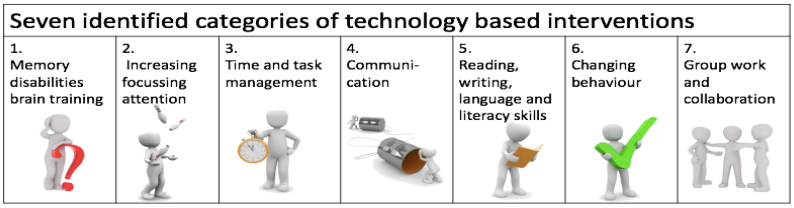


Figure 15 Seven categories of technology-based interventions

The review suggests these categories as inspiration for teachers working with learners with developmental and attention difficulties, but clarifies at the same time that

> "the number of studies in each category is in general very low and the number of participants few. Even though promising use of technologies are identified, the small collection of studies leaves with very mixed results" (Andersen & Jensen, 2018 p. 22).

Retrospectively, it would be fair to ask how these mixed findings may guide teachers in development of an including practice. Following the framework of Skovsmose & Borba (2004) the research review can function as inspiration for the teachers' pedagogical imagination as they can increase their knowledge about educational alternatives and include them in new visions for imagined situations. Specific technologies available in schools can be connected with the identified categories of assistive technologies (figure 16), but it will hardly be sufficient to provide clear guidance for the teachers.

Figure 16 Connections between the categories of technology-based interventions and the technologies available in the school

It cannot be expected that insights from the review can be transferred with the same results into any given pedagogical practice. As suggested by Hoppestad (2007) and Hall et al. (2012) it may be necessary to adopt a more holistic approach where the technologies, the individual learners, the environment, and the tasks are considered concurrently in order to design sustainable solutions.

Following this approach, making knowledge visible may only be considered as a first step where teachers are informed about how technologies have demonstrated to be an important supportive pedagogical tool in other contexts. A second step may then be to support them to utilise this potential into new local arranged situations and plan how they pedagogically can organise this to happen with respect to the individual learners, the actual context, and specific tasks in the current situation.

Unfortunately, teachers do not have easy access to research literature, why they will not necessarily learn about such findings and alternative solutions as presented in the research review. On the other hand, they have an extensive shared practice knowledge, which as well may function as inspiration for their pedagogical imagination. Such knowledge will probably not be adequate, when teachers meet new and unfamiliar pedagogical situations as e.g. including a new group of learners with special educational needs they do not understand or implement technologies they cannot wield. When coping with new and emergent pedagogical challenges it seems crucial to provide teachers with knowledge from experts, researchers, and other professionals, who may stimulate their pedagogical imagination and help them to develop visions for new imagined situations. How this can be carried out will be discussed later in section 6.4 'Making the support visible'. It may be concluded that making knowledge visible may be considered as an initial step in the support of developing the teachers' educational practice as illustrated in figure 17.

Figure 17 Framework for teacher support step 1: Making the knowledge visible

6.2. MAKING THE COMPLEXITY VISIBLE

Technology as a Vehicle for Inclusion of Learners with Attention Deficits in Mainstream Schools

"The potential of technology for supporting educational processes of participation, collaboration and creation is widely accepted. Likewise it has proved to enhance learning processes for disabled learners (e.g. supporting dyslexia students with digital tools such as text-to-speak-programs or writing-support programs). A currently topical group, politically and educationally, in the discourse of inclusion is learners with extensive developmental and attention deficit disorders (e.g. Attention Deficit Hyperactivity Disorder (ADHD), Attention Deficit Disorder (ADD), Autism Spectrum Disorder (ASD), Autism etc.). This paper investigates the potential of technology for supporting the inclusion of this group in the general school system, i.e. into mainstream classes, using technology as a tool to join, participate, and contribute – and as a vehicle for general human growth in their learning community. The paper presents the primer results and describes and discusses the challenges of both teachers and learners, involved in the inclusion process. Finally, on the basis of findings, a typology of tools is suggested, which may support inclusive teaching and learning for the target group in question" (Abstract in Andersen & Sorensen, 2017a)

As we know from chapter two, inclusion is not a simple concept deal with. A missing unambiguity and the different discourses might leave a 'window of opportunity' for the conditions for inclusion (Engsig, 2015), but it might as well leave the teachers and the schools with an indefinable, complex and maybe impossible task to fulfil these different (and often contradicting) expectations (Ratner, 2012). As described in chapter 2, the concept of inclusion is complex and the definitions numerous (Erten & Savage, 2012).

Resting on an understanding of inclusion as a situation, where a person joins, participates, and contributes in the academic and social community – as a citizen in the society or as a student in the school (section 2.2), the next paper in this dissertation investigates which technologies - available in basic schools - may support respectively physical, social, or academic inclusion of learners with developmental and attention difficulties (Andersen & Sorensen 2017a).

On the basis of one year of research in five schools, where teachers and researchers have been working together and collaboratively investigated the including potential

of technologies in the basic classroom setting, this paper seeks to reduce the complexity by highlighting some patterns from these experiences. Consequently, five categories of technology-based interventions are identified as specific valuable for the focus learners:

1. Structure & Overview
2. Shielding & Focus
3. Differentiation & Comprehension
4. Production & Communication
5. Dialogue & Collaboration

These initial findings call for further investigations into this five-types-model of including technology-based interventions (ibid.) which is carried out 2015-2017 (Andersen, 2015; Andersen & Sorensen, 2017b; 2017c; Sorensen & Andersen, 2017a; 2017b) and will be presented in the following sections.

Retrospectively, it may be valuable to examine how these identified categories can be operationalised into forming an inclusion perspective. Originally the preliminary model was presented with five equated categories (figure 18A), while following critical reasoning have aimed for further simplification and tentatively argued for a hierarchic (figure 18B) or subordinated (figure 18C) correlation between the categories (Andersen et al., 2017). Additional research seems, though, necessary to validate or reject these hypotheses.

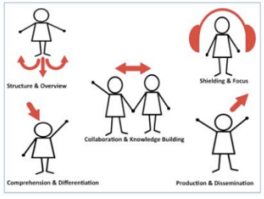


Figure 18A:
An equated model

Figure 18B:
A hierarchic model

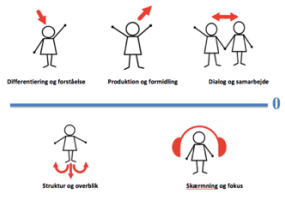


Figure 18C:
A subordinated model

Figure 18 Iterations of connections between the categories of technology-based interventions

From the perspective of today it seems rather fruitful to reuse Alenkær's IC3 model of inclusion (Alenkær, 2017) to try to understand how these five categories can be operationalised into practical organisation of new including arranged situations (figure 19).

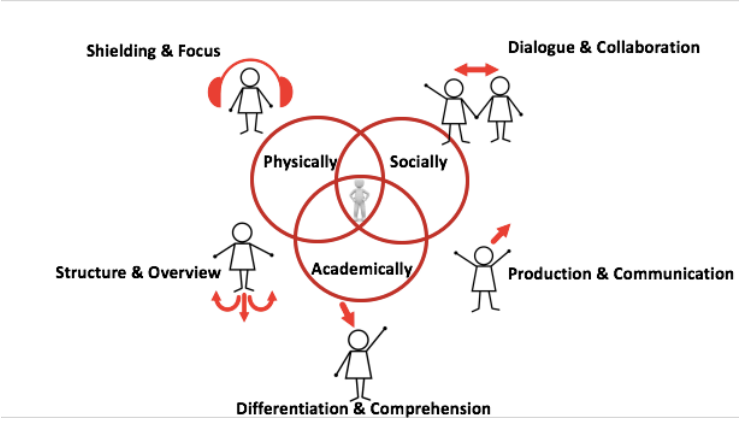


Figure 19 The five categories of technology-based interventions related to the model of inclusion

The paper focuses on how technologies can be used as a shielding tool to increase focus and support inclusion at a physical level. Technologies used as a structuring tool can provide an overview, which may support participation at both a physical and an academic level. Various kinds of technologies and digital modalities increase the possibilities for differentiation which support comprehension at an academic level, while technologies for production can support both expression and communication, and with it both academic and social inclusion. Finally, technologies can be used as a tool for dialogue and collaboration and in that sense support inclusion at a socially level. Though, it is necessary to regard the model dynamically, since e.g. dialogue and collaboration as well may function as a structuring or shielding tool and support focus learners in overviewing and focussing on a given task.

It is not always possible to reduce complexity. Ratner (2013) describes how schools instead may learn 'to exist' in the complexity, which means that they may learn to live with day to day compromises and not expect they can deliver 'the picture perfect of inclusion'. Facing that, may actually reduce the complexity in itself (ibid p. 187). For the same reason, it could be considered to use the verb 'including' rather than the noun 'inclusion' to describe what may be expected by teacher professionals. Collaborative critical reasoning in schools may help to acknowledge, that the imagined situation (inclusion as a goal) is an ideal, which we may never reach, but continually striving towards when developing including arranged situations (including as a process).

The identified five-category model for technology-based interventions leaves in itself no clear answers and quick fixes for support of teachers into development of innovative pedagogic including designs for learners with developmental and attention difficulties. But the model may potentially serve as a complexity reducing

factor when developing pedagogical alternatives. Consequently, visualising and understanding the complexity of both the concept of inclusion and the potential of technology may be a valuable next step in a framework for supporting teachers in development of an including, technology-based practice (figure 20).

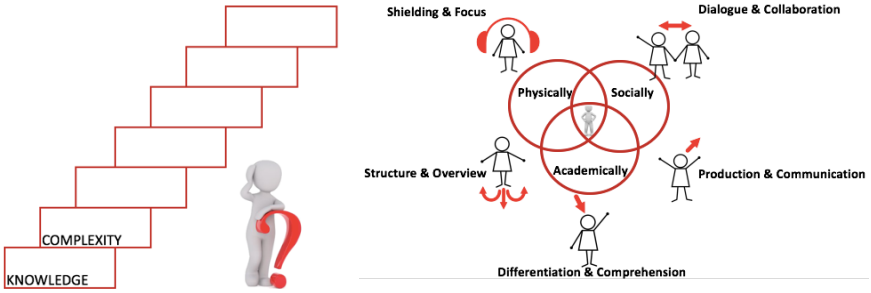


Figure 20 Framework for teacher support step 2: Making the complexity visible

6.3. MAKING THE LEARNERS VISIBLE

Inducing omnipotence or powerlessness in learners with developmental and attention difficulties through structuring technologies

"Schoolwork of learners with developmental and attention deficits is often characterised by low productivity, many errors due to carelessness or inattention and poor organisational ability. Focus learners have difficulties performing at the same level as their peers. This paper addresses the challenges and investigates the potential of technologies for creating and facilitating environments, where learners are well-supported with respect to overviewing, structuring and planning tasks, evaluating and adjusting participation and management of time." (Abstract in Andersen & Sorensen, 2017b

As described in chapter 3.3 a focus learner's development of a solid self relies on the extent to which he experiences powerlessness or omnipotence when he meets challenges and frustrations. Omnipotence increases a learner's willingness to deal with things, while powerlessness causes him to search for protection and confirmation (Kohut, 1990). If a learner to a high extent experiences himself powerless, he may be left in a condition of invincible frustration and loses his faith in his own possibilities and abilities (ibid.).

On the basis of interventions at eleven schools, the third dissertation paper describes how technologies have been used to support 56 focus learners in their learning processes by providing structure and increasing overview. The findings identify in these contexts five fundamental ways for using technology to decrease powerlessness and increase omnipotence (Andersen & Sorensen, 2017a). As illustrated in figure 21, these subcategories of technology interventions have shown to support inclusion at a physical and academic level as they function as structuring tools and provide focus learners an overview they are hardly able to establish themselves and thereby reduces some of the causes to frustration, conflicts, and threats.

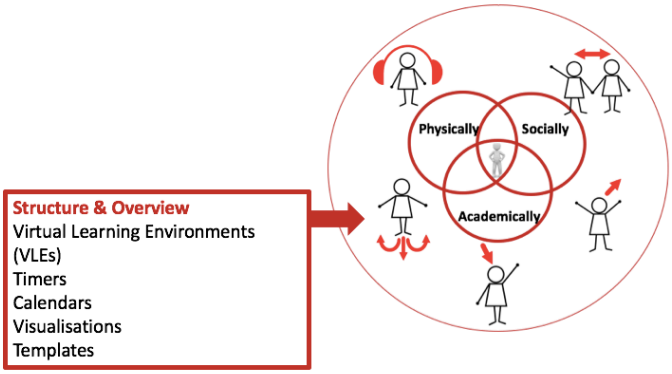


Figure 21 Technology-based interventions for supporting structure and overview

With Virtual Learning Environments (VLEs) it is possible to collect all material and tools in one place, timers and calendars may tell the learner what to do and for how long time, visualisations may support understanding and memory, while templates can brake complex tasks into manageable components and provide a road through the problem solving processes. The research shows how these tools have assisted focus learners, motivated and enabled presence, participation and achievements in school (Andersen et al., 2017 p. 80-86), why they may be considered as valuable in development of including pedagogic designs. Apparently, they will be a powerful tool for both focus learners and peers as all learners seem to feel more comfortable and less stressful when they command their day at school autonomously. The study emphasises that the potential of structuring technologies is only to some degree utilised if the teachers are not aware of the individual learners' specific needs and provide individual customised solutions based on this awareness (Andersen & Sorensen, 2017b; Sorensen & Andersen, 2016).

From the perspective of today, it may be relevant to ask how this awareness on the learners' individual needs can be enhanced.

Brinkmann & Petersen (2015) problematize that, to a high extent, we have developed what they call a 'Diagnosis Culture', where common human conditions are often described in psychiatric terms as e.g. depression, grief, anxiety etc. In the psychiatry, diagnoses are useful to separate different conditions and identify if clinical treatment is needed. Diagnoses give as well access to different kinds of special allowances as e.g. special educational support, and provides explanations and a realm of understanding for both 'the patient' and relatives. The amount of possible diagnoses is increasing and so is the amount of diagnoses (ibid.). From this perspective it could be said, there is a demand for labelling.

Simultaneously, the inclusion policies and practices have caused what Ratner (2013) describes as a discriminatory dilemma, where it is regarded as excluding if the school focuses on specific children's special needs. When the ideal of inclusion defines all children to be unique and having individual needs, it calls for a precedence where children are not diagnosed or described as having difficulties. They are in context of challenges and practitioners are encouraged to focus on the environment rather than the specific child. Ratner (2013) recommends a compromise between the individual learner's needs and the ideal of inclusion when stating:

> "There is a risk that some children's challenges are made invisible, if we are not allowed to talk about them as special. As practitioner you may always be conscious that it may stigmatise to make discriminatory practice, but it may as well impact children's well-being and learning if you avoid to do so" (ibid. p. 192)

In the fieldwork of ididakt, focus learners' special educational needs are identified by the teachers by use of approved quantitative diagnostic tools - ADHD-RS Rating Score Scale (Poulsen, Jørgensen, Dalsgaard, & Bilenberg, 2009), SDQ – Strength and Difficulties Questionnaire (Obel, Dalsgaard, Stax, & Bilenberg, 2009) and HOV – Memory, Organisation and Persistence Survey (Jensen de López, 2013) – combined with explorative open qualitative tools (Andersen et al., 2017 p. 67-68). Pros and cons by these tools can be found.

While the open qualitative tool maybe does not exposure all challenges and needs, there may, on the other hand, be a risk of increased problematization when using the standardized diagnostic tools (Brinkmann & Petersen, 2015). However, the fieldwork exposes how these tools effectively initiated a shared language and shared visions for pedagogical interventions among teachers (and researchers).

Unfortunately, the fieldwork exposes as well how some schools do not have a collaborative practice for supporting such a shared endeavour. In some settings, it was impossible for the main teacher to make any agreement with subject teachers. In another setting relevant knowledge from psychologists was found in the pupils' files, while the teachers had no knowledge on these important reports. On a third

school important recommendations from the National Knowledge- and Specialist Counselling Organisation (VISO) were not used and implemented. Such findings may lead to the conclusion that new identification and implementation processes seem needed.

According to Skovsmose & Borba (2004) pedagogical imagination is conceptually exploring educational alternatives to a current educational situation and may express

- A historical sensitivity acknowledging what has happened before
- An anthropological sensitivity acknowledging what has been done elsewhere
- A critical sensitivity which does not take the current situation as given

As pedagogical imagination has a current situation as point of departure it may be necessary to focus carefully on the current situation and describe the individual learners from these three perspectives. Skovsmose & Borba (ibid.) suggest the process of decision making facilitated through negotiation and deliberation between researchers and teachers based on the idea that nobody has access to unquestionable knowledge.

Combining this sophisticated idea for further development of new including practices with recommendations for school-based interventions (DuPaul et al., 2011) invites to consider collaboration between colleagues, learners and parents at all stages when:

- Defining current situation
- Discussing imagined situation
- Implementing alternative solutions
- Evaluating arranged situations
- Redefining through critical reasoning

The different stakeholders may from various perspectives combine the solutions with knowledge and experience, and invite them to be acting subjects in a shared endeavour and not objects for observation. Based on such understanding it may be fruitful to develop a pedagogical agenda where both teachers and learners have more agency in investigation of a learners' specific challenges and needs. An agenda focussing on visible learners rather than visible learning.

In the study of ididakt 166 learners are asked to describe what makes the difference between respectively a good and a bad in school; hereof 22 focus learners and 144 peers. The study makes it clear, how focus learners and peers have different preferences as illustrated in figure 22.

Figure 22 Differences between themes of importance in school for respectively focus learners (left side) and peers (right side)

As significant elements in a good day at school, both focus learners and peers mention to have friends, to play with somebody, to have fine breaks as important. When peers are most concerned if they can concentrate, understand and do the tasks in a quiet atmosphere without disturbances, it seems of more importance for focus learners if teachers are nice, happy, do not scold, and provide necessary assistance.

Visible learners may inspire teachers' practical organisation and, thus, catalyse new arranged situations to pay attention to preferences of different learners. In this case the desire from learners with developmental and attention difficulties would entail an awareness in the teaching design on

- Arranging work in smaller teams
- Avoiding scolding and complaining
- Encouraging peers to help each other
- Ensuring enough time and avoiding too many tasks
- Considering if focus learners are tired or grumpy in the morning

In development of a future 'Inclusion 2.0' approach it would be interesting to bring more agency to children and involve them in development of the school. There seems to be a call for educational research in bottom up development processes respecting local differences and educational purposes.

From literature and field work it is noticed that learners with attention and developmental difficulties can be very visible in classroom settings. Teachers and classmates notice maybe at first a bodily fidgety, verbal impatience, and physically fierce reactions. Diagnosing children is not a teacher's task, but tools for supporting

teachers in making learners visible may be important for development of including teaching practice. Thus, it seems to be a call for pedagogic rather than diagnostic tools[7]. A suggestion for the next step in the framework may then be a collaborative elucidation of the current situation and the challenges in the school setting from the perspective of the focus learner (figure 23) when asking:

1. How is the focus learner challenged when it comes to overviewing the day, the tasks and knowing what to do? Does he need any **structuring** support?
2. How does the focus learner cope with impressions in the classroom from e.g. sounds, noises, visions or presence of other people? Would he manage better with a **shielding** support?
3. To which extent does the focus learner understand the content in the lessons? Is it necessary to provide any **differentiated** materials?
4. To which extent is the focus learner able to carry out the assignments in the different subjects? Can he be supported to achieve better with any **production** support?
5. How is the focus learner handling working with peers? Will there be any gains if **dialogue and collaboration** were supported?

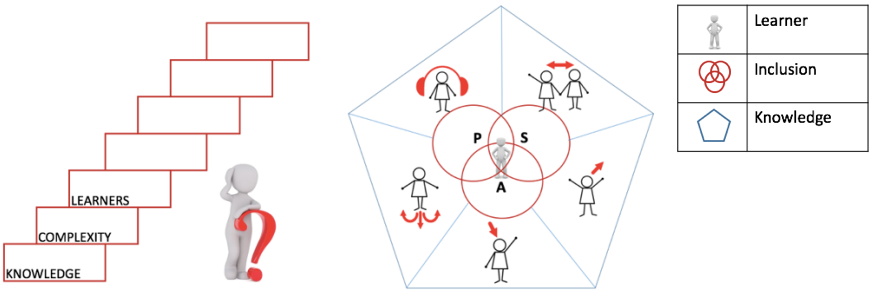


Figure 23 Framework for teacher support step 3: Making the learners visible

[7] An attempt to develop such a framework is made by the Danish Ministry of Education based on findings from the ididakt research and the papers behind this thesis (STIL, 2017) to be launched spring 2018.

6.4. MAKING THE SUPPORT VISIBLE

Supporting Inclusion of Children with Attention Deficit-Hyperactivity Disorder using Sound-Field-Amplification-Systems

"ICT is internationally recognised as a valuable tool for inclusion, particularly for people with disabilities, where technology can improve their quality of life, reduce social exclusion and increase participation in life and learning. This study examines the impact teachers and learners experience in proportion to classroom and on-task behaviour among children with developmental and attention deficits when using personal Sound-Field-Amplification-Systems in the classroom. The aim of increasing knowledge about 'good practice' when Sound-Field-Amplification-Systems are put into action will uncover further implications when implementing this technology in schools" (Abstract in Andersen, 2015).

When teachers are requested to work with new groups of learners, develop their classroom strategies and implement new technologies, they are calling for support to understand and manage the learners' needs pedagogically (Danmarks Evalueringsinstitut, 2011) and the tools technologically (STIL, 2017). The significance of such teacher support is illustrated in the fourth dissertation paper where the potential of using Sound-Field-Amplification-Systems (SFAS) as a shielding tool to increase focus during classroom teaching is investigated (Andersen, 2015).

SFAS is a technology which enables learners to hear the teacher's instructions clearly. The technology works by a teacher microphone for projecting the teacher's voice and a student receiver combined with different kinds of headsets. Offhand the technology seems to be easy to implement in a classroom setting. As the technology is new to all participants some support is provided:

1. An initiating keynote with an expert on pedagogy for learners with ADHD/ASD (by the author of Bohr, 2013 & Bohr, 2011)
2. Local presentation of the technology by a hearing aid company (Comfort Audio) who also puts the SFAS at disposal for the schools, and
3. Weekly dialogues with researchers in a research blog.

The SFAS is used in 8 classes and evaluated in relation to 18 focus learners. The results indicate a considerable positive impact for 13 pupils on classroom behaviour as e.g. staying calmer in the lessons, enhanced awareness and focus when following class teaching, enhanced participation in classroom teaching and enhanced concentration by individual school work (Andersen, 2015).

> "A total of 41% of the answering teachers tested the SFAS and 82% of them expressed that SFAS have a good impact when including children with attention and developmental deficits in their daily practice, while 18% said that it had no impact. None of them described any negative impact" (Andersen, 2015).

As illustrated in figure 24, the study reports on further experiments with other kinds of SFAS technologies (e.g. Google Hangout on iPads during classroom teaching), different ear defenders or virtual presence in the classroom as alternative shielding strategies with similar positive impact (Andersen, 2015; Andersen et al., 2017 p. 87-92).

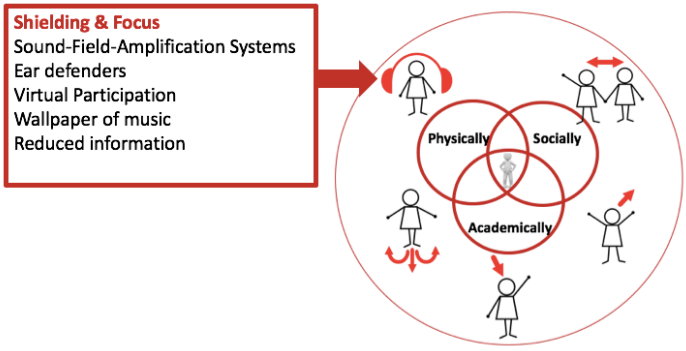


Figure 24 Technology-based interventions for supporting shielding and focus

Consequently, it may be expected that schools and teachers implement these new positive experiences in their daily educational including practice, but surprisingly, they did not. Observations and interviews provide various explanations: The price is too high, the teachers cannot overcome technical challenges, the teachers are afraid of exposing pupils with special equipment or they cannot reach an agreement in the team on using SFAS. In one school a teacher describes good experiences with SFAS for 2nd graders and how the learners later asked for further use of the system, but neither here is the intervention afterwards carried out. The teacher explains:

> "I cannot find the charger for the microphone – and I have forgotten how effective it was. But it was also somehow difficult for my practice in the classroom, because the dialoguing shifted to one-way communication from the teacher to the students, when everybody was shielded with headphones" (Andersen, 2015).

Reflectively, consideration evolves if this teacher may have continued developing his interventions, if he was provided technical support (to fix the equipment in the classroom) and pedagogical support (to refine his technology-based pedagogical

design). Later interviews expose how the same teacher twice a month attends counselling meetings with the local Special Education Expert Team at the school and asks for support in the classroom without receiving any useful advice. The teacher says he tries whatever they suggest but so far with no further impact. He, though, persistently attends these meetings to avoid later to be claimed for not informing about individual learners' challenges. Another teacher recounts how she is recommended by a counsellor from PPR to use the CAT-kit[8]. When asking how to work with it, the counsellor replies *'I have not used it myself – take a look in the manual'.*

From the perspective of today, it would be of great value to investigate how teachers may be supported adequately. Reviewing actual pedagogical literature exposes much advice regarding what teachers may know and be able to do, but recommendation about how they may require such knowledge and skills seems harder to find.

When it comes to inclusion and pedagogy, Hattie (2012) describes e.g. what it takes to be an expert teacher, but not how to become one. Mitchell (2014) provides 27 evidence-based strategies for including teaching but none about skills upgrading of teachers. Ratner (2013) suggests a reflecting practice as a tool for development of including schools but exposes an important dilemma regarding inclusion: A teacher, who cannot include a child may be blamed for his lacking ability to be reflecting and acknowledging. How should teachers be able to reflect their own limits? (ibid. p. 15)

Remvig (2016) categories teachers into four types when preparing them for implementation of new technologies: the competent, the insecure, the perplexed, and the sceptic. She suggests different approaches for competence development for the different groups (e.g. introduction courses to technology competent teachers and peer-to-peer training for insecure and perplex teachers). Bates (2015) clearly expresses what institutions can do to facilitate (or impede when doing nothing) the development of knowledge and skills required for teaching in a digital age:

- Adequate training in the new technologies
- Adequate methods of teaching in a digital age
- Adequate learning technology support
- Adequate conditions to enable this kind of teaching (e.g. class size, equipment etc.)

[8] CAT-kit (Cognitive-Affective-Training) is a method for inspiring and structuring conversation between people on thoughts, emotions and behaviour using a set of carefully designed tools, collectively referred to as the CAT-kit (CAT-kit.com, 2017).

- Adequate development of practical and coherent strategies to support this kind of teaching (ibid. p. 422)

The lack of support in the teaching practice has been a consistence issue throughout the study. When teachers call for support, they might receive information or inspiration, but they have to figure out themselves how to conduct new initiatives. Follow-up supervision into the classroom setting seems to be non-existing.

When initiating and developing interventions in the study, the researchers provided to some extent supervision in the processes of pedagogical imagination, practical organisation and critical reasoning. But when the spotlight from a research project is turned off, who will them provide such support? It seems to be a very important question to address. Using critical reasoning as a strategy for looking 'through' some of the arranged situations in the study of ididakt in order to provide a better understanding of the imagined situation (Skovsmose & Borba, 2004 p. 18), it becomes clear how often supervision potentially may have made a difference. Table 10 illustrates some examples.

Support for	May be valuable for
Evaluating if a schools visions of inclusion actually fits into a real classroom setting (E.g. by questioning school leaders: Is this vision possible for the teachers to carry out?)	Development of imagined situation
Observing if chosen interventions in reality are carried properly out (E.g. by questioning teachers: How can this intervention be improved?)	Development of practical organisation
Considering if the arranged interventions are actually sufficient to support the learner (E.g. by questioning pupils and parents: Is further support needed?)	Critical reasoning regarding current and arranged situation
Assessing if chosen interventions are possible to implement (E.g. by questioning teachers: Is it possible for you to carry this intervention out?)	Critical reasoning regarding current and imagined situation

Table 10 Examples of supervision possibilities which have not been acted out in the study

Based on experiences from the full study, it may be fair to conclude a lack of visible and relevant support leaves the teachers to fend for themselves, while all the effort, hard work, and positive experiences from various development initiatives or research projects easily come to nothing. It may be relevant to suggest that support

of teachers encompasses postgraduate courses regarding inclusion, special education and technology, but maybe of more importance supervision provided closely related to the teaching practices in the classroom. Not only as guidance when implementing new interventions, but even more critical as supervision during regular adjustment of interventions. Consequently, it seems relevant to propose the next step in a powerful framework as initiatives that gather necessary stakeholders and experts around the teachers (as e.g. PPR, SEN teams, technology advisers or school leaders) and clarify how they can support the classroom initiatives economically, pedagogically, and technologically as illustrated in figure 25.

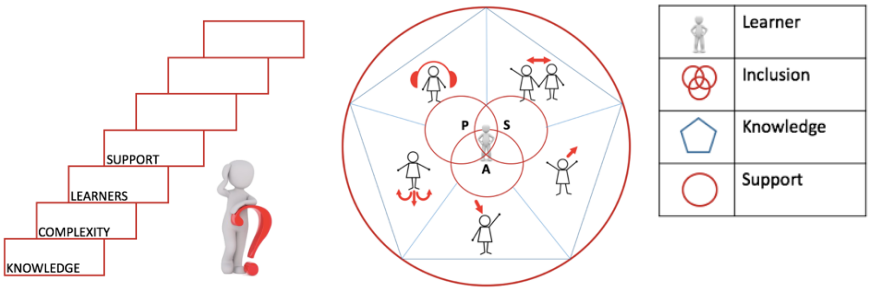


Figure 25 Framework for teacher support step 4: Making the support visible

6.5. MAKING THE PEDAGOGY VISIBLE

Enhancing understanding, flow and self-efficacy in learners with developmental and attention difficulties through ICT-based interventions

"The purpose of this paper is to investigate in which ways technologies may be used to increase inclusion and a feeling of flow and self-efficacy in learning processes when it comes to learners with developmental and attention deficits (focus learners) in a mainstream classroom. The paper is one piece of outcome of a wider study on ICT facilitated inclusion, and this current piece of research addresses the challenges of enhancing focus learners' comprehension when working with the curriculum. Several technologies have been tried out in a real school context and seven types of interventions are identified as valuable for focus learners' capability in learning processes. The paper discusses the findings and concludes that conscious use of technology-based interventions makes it possible to provide learning challenges balanced to the learners' individual skills. But a broader understanding and acceptance by all stakeholders of the specific challenges of this group

	of learners in mainstream educational systems seems needed to fulfil the potential" (Abstract in Andersen & Sorensen, 2017c).

A learners' motivation for engaging in learning processes can be stimulated when he works with topics of value or interest (Rogers & Freiberg, 1994; Colaizzi, 1978) or when he experiences himself to be able to contribute with something of importance – for himself or for others (Wenger, 2008). Digital technologies contain great opportunities for construction of learning products as multimodal reifications (Dalsgaard & Sorensen, 2008), which both can serve to facilitate the learners' understanding of the content matter (as a consumer) and to disseminate the learners' knowledge and communicate to himself and others what he is able to do (as a producer) (Murchú & Sorensen, 2009).

The fifth dissertation paper investigates how technology can be used to enable learning by promoting differentiation and comprehension (Andersen & Sorensen, 2017c). Two key factors are used as analytic optic – the theory of flow (Csikszentmihalyi, 1997) and the theory of self-efficacy (Bandura, 1997). The theory of flow describes how learners can be motivated for learning when experiencing an appropriate balance between ability and challenge (section 3.3.6), while the theory of self-efficacy (section 3.3.6) outlines how a learner's belief in his own ability to succeed in a situation or accomplish a task affects a learner's approach to challenges (section 3.3.7). Using the work of Schaffer (2013) the paper demonstrates how different technologies have been used to promote flow and self-efficacy when supporting learners to:

1. Perceiving their own skills
2. Knowing what to do
3. Knowing how to do it
4. Knowing how well they are doing
5. Knowing where to go
6. Experiencing minimised distractions
7. Perceiving the challenges

On the basis of this work seven types of technology-based interventions are identified as valuable for enabling differentiation and enhancing comprehension in the learning activities (Andersen & Sorensen, 2017c) as shown in figure 26 and described as follows:

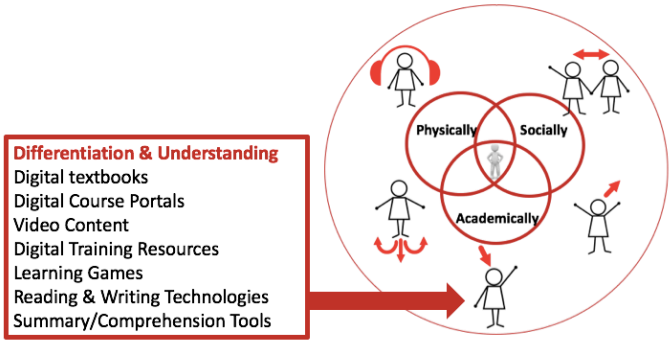


Figure 26 Technology-based interventions for supporting differentiation and comprehension

> "Digital books give focus learners access to both fiction and non-fiction at a higher intellectual level than they might be able to read on their own. Assistive reading and writing software helps them to work faster and perform at a higher level. Digital course portals and digital summary tools offer them an overview on the curriculum and easy 24/7/365 access to material in many modalities. Video content, learning games and digital training resources have in this project proved to be motivating and engaging for the focus learners and offered them new ways to work with the curriculum" (Andersen & Sorensen, 2017c p. 171).

According to the conclusion, this suite of technology-based interventions has demonstrated to offer focus learners learning tasks in respect to their specific challenges and skills (ibid.) and, thereby, possibilities for working in flow, which combined may enable development of self-efficacy. Even those findings seem very delicate, it is, unfortunately, not possible to conclude, they will work in that way in any learning environment. The engagement in learning for instance, cannot necessarily be cultivated purely through these interventions.

Inspired by the work of Fogg (2003), it may retrospectively be relevant to consider how diverse pedagogical approaches may impact learner engagement differently. By stating engagement in learning to be profoundly dependent on the learner's behaviour, Fogg identifies in his BMAT model (Fogg, 2009) three core factors for changing behaviour: motivation, ability and trigger. Similar to Csikszentmihalyi's model of flow (Csikszentmihalyi, 2014), the BMAT model presents 'motivation' and 'ability' at respectively a vertical and a horizontal axis, but, furthermore, it provides a guidance into how different triggers may cause a change of behaviour in the different zones as shown in figure 27 and described below (Fogg, 2009).

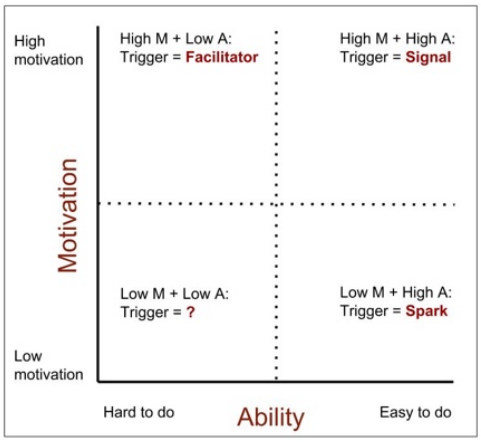


Figure 27 The BMAT model: Behaviour = Motivation + Ability + Trigger (Fogg, 2009)

If both motivation and ability are high a learner can be engaged with only a signal: 'Here is your task, deadline is tomorrow'. If the motivation is high and the ability is low, a teacher might succeed with facilitating tools as those recommended above: digital textbooks, different modalities, reading and writing tools, templates, summaries etc. If motivation is low and the ability is high, it is necessary to trigger behaviour with a spark to ignite the engagement. It may be initiated by appreciating dialogues, motivating learning games or meaningful and relevant tasks. But if both motivation and ability are low we are, according to Fogg, facing the activation threshold and triggers will fail as shown in figure 28 (Fogg, 2007).

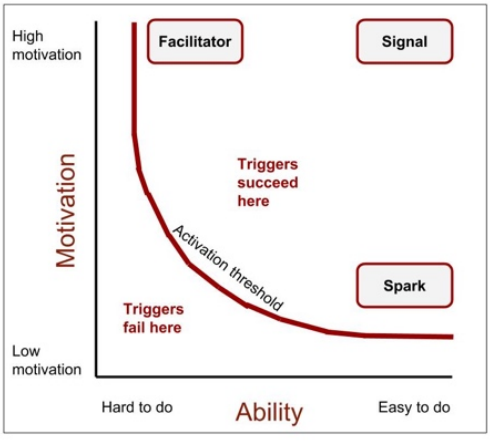


Figure 28 Triggers fails beneath the activation threshold

Unfortunately, many learners with developmental and attention difficulties are trapped in this futile zone in the including classroom activities. It may be possible to reverse this poor situation, if teachers through critical reasoning became aware of the correlation presented by Fogg (2207). If teachers consequently used this insight to change the practical organisation and develop new arranged situations, where the activities feature topics of interest and easier tasks or both, they would ensure focus learners a possibility to be engaged over the activation threshold.

Even if the technologies presented by Andersen & Sorensen, 2017c) make it easier for the learners to solve the tasks, it will still be crucial to ignite the learner's interest if engagement and learning may occur. Some compromises may be necessary; a few examples will be discussed below.

The teachers in two 2nd grade classes provided the learners very structured triggers with signals and facilitators: The learners started every lesson (90 minutes) with a 'check in' procedure, where they wrote what was learned in the previous lesson and what was the goal of today. At the end of the lesson they did the 'check out' procedure and evaluated what was learned and how well they had been working. The tasks for the observed lesson were clearly structured and the learners knew what to do, for how long, with whom etc.

All these initiatives may be considered as enabling flow and engagement above the activation threshold. But the goal of the day seems maybe not that motivating for 2nd grade learners: 'I have to be familiar with different strategies during my before-reading' was written at the whiteboard. In this specific case, the activities seem to be led after a mechanically practical organisation rather than a pedagogical vision. From the perspective of an observer the lack of sense making inhibits the learners' engagement in the activities.

In the ididakt project a team of teachers decided to change their pedagogical strategy and divided two 4th grade classes into several groups and gathered focus learners in one group, where they could work with learning activities suitable for their actual abilities and topics of interests. The teacher structured the activities in a very detailed way in order to increase the level of autonomy by the focus learners. After some weeks, they evaluated and found that the focus learners felt very successful and every day left the school with a big smile satisfied with their performances. But the teachers objected, as well, that they were excluding these focus learners from the original learning activities and learning community in order to improve their feelings of success and self-esteem. In other words, they were excluding the learners from the classroom in order to include them in the basic school system. The same approach was carried out by the teachers in 8th grade, but they were either struggling with parents who did not accept that their children did not meet tasks at the same level as their peers or with the demand on preparing all learners for the same final examination.

These examples illustrate how difficult it can be to organise an arranged situation which fits conflicting expectations and imagined situations. In the first example the teachers were demanded by a learning consultant to use a specific method for their practical organisation and got blocked on this task. If they had used the framework of Fogg (2007), they might have noticed that their nearly perfect facilitation had no effect due to the missing motivation for the senseless task. In the second example, the teachers had increased the learners' engagement and feeling of success, by lowering the level of complexity and providing a conscious pedagogical scaffolding, but their pedagogical imagination was not in sync with other stakeholders. The framework of Fogg may have provided them tool for discussing the impact of pedagogical alternatives with parent.

Due to the wide spectrum of difficulties no clear benefit on any specific approach for treatment or teaching seems easy to identify (Steiner et al., 2014), why teachers need a suite of strategies or tools for ongoing elaboration of suitable solutions in their daily practice. It seems impossible for teachers to meet everybody's requests and that is why compromises are inevitable and will impact the pedagogical choices related to the including interventions. As recommended by Ratner (2013) schools may not only discuss how they include, but also how they exclude (ibid. p. 194). Making the pedagogy visible is suggested as the next step in framework for supporting teachers to develop technology-based including interventions (figure 29). It is about being aware of pedagogical choices and be willing to argue for them. It encompasses critical reasoning about pros and cons with teacher colleagues, dialogues with parents and school leaders in order to build a shared responsibility for the development processes with all stakeholders.

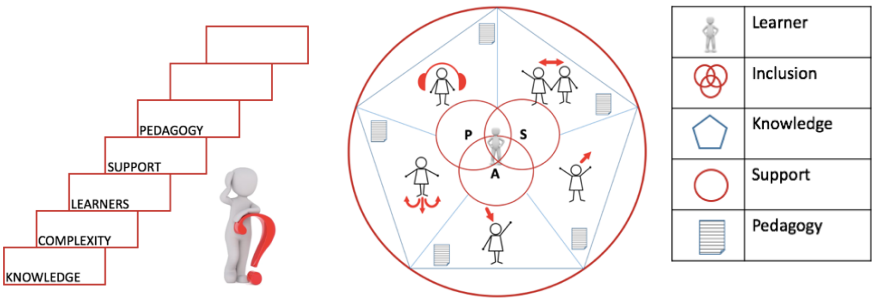


Figure 29 Framework for teacher support step 5: Making the pedagogy visible

6.6. MAKING THE TECHNOLOGICAL PURPOSE VISIBLE

Strengthening Inclusion of Learners with Attention Difficulties Through Interventions with Digital Technology in Processes of Production

"This paper investigates the potential of digital technologies for strengthening the participation and inclusion of learners with developmental and attention deficits (focus learners) into the mainstream classroom. The paper describes the authors' approach to the challenge of researching the extent to which digital technologies may support the learning process of focus learners – in particular, in those aspects of the learning process that deal with the construction of learning products and the communication and dissemination of knowledge to peers, teachers or others. On the basis of the actual analysis and a succeeding discussion, the paper concludes that in order to create ownership, pedagogic strategies and interventions with digital technologies (whether viewed from the perspective of teaching or the perspective of learning) should incorporate opportunities for developing digital multimodal reifications. These, in turn, then stimulate learner reflection and awareness. Finally, the authors of the paper emphasize importance of opportunities for reflection, tools and structures for construction and dissemination of learners knowledge (to demonstrate 'I am able to' and 'I know')" (Abstract in Sorensen & Andersen, 2017a)

During the participatory action research processes questions such as 'Which program or app should we use?' are frequently raised. When answering 'It depends on what you want to attain', the questioner has often been disappointed. But the technologies have to be put intended into action, why it is crucial to clarify the purposes for the intended use and actual circumstances through critical reflection: Are the technologies at hand able to facilitate the focus learners' communication and expression of thoughts, statements, insights, questions and answers at an academical level? Have the technologies proven an impact for supporting collaboration at a social level? And do they support the focus learners' attendance in the classroom at a physical level?

The sixth dissertation paper (Sorensen & Andersen, 2017a) demonstrates how inclusion can be strengthened through interventions, where digital technologies in processes of production assist focus learners to acknowledge 'what they know' and 'what they are able to' and in that sense stimulate their self-efficacy (Bandura, 1997). As illustrated in figure 30, the study identifies three purposes for using technology:

1. Scaffolding processes (e.g. templates, document sharing, learning management systems (LMS), mindmap programs as e.g. Mindmeisteretc.)
2. Enabling production (e.g. Office or Google applications, Multimodal programs as e.g. iMovie, GoAnimate, Pixton, WriteReader etc.)
3. Assisting comprehension and communication (e.g. reading and writing technologies as Text-to-Speech, Word Prediction or Speech-to-Text) (Sorensen & Andersen, 2017a p. 49)

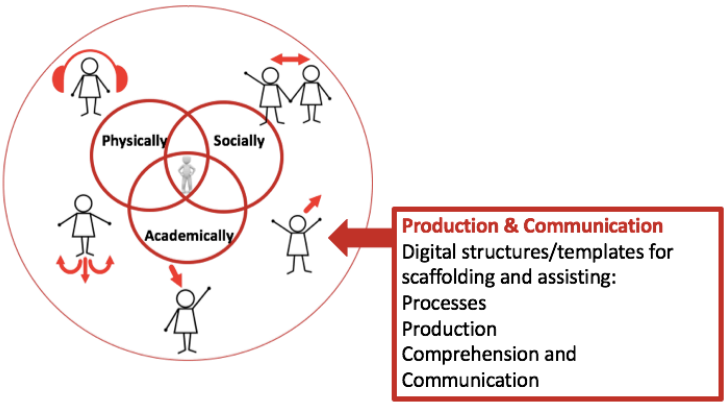


Figure 30 Technology-based interventions for supporting production and communication

The paper presents numerous situations, where focus learners are empowered through these tools to act as true agents with both ability and power to control the learning processes (Andersen & Sorensen, 2017a.; Andersen et al., 2017 p. 100-107). Is it possible to imagine that such positive experiences in a longer term may lead them to a realisation upon a similar empowerment to control their own lives? The study argues how various digital technologies make it possible to promote genuine including learning where:

1. Focus learners' participation and control are significant in relevant processes that are true to them (promote empowerment)
2. Focus learners participate and external treats are low (promote flow)
3. Focus learners are assessing their own progress and success through reflection and meta-reflection (i.e. learning to learn) on their digital products and working processes (promote self-efficacy).

> "To be included is, in itself, a life value for the unique individual/learner. To feel included, a learner must feel safe and secure in the learning endeavour… To reduce risks, any fruitful pedagogical approach should employ digital technologies and interventions in ways that empower learners and promote a learner experience of inclusion, and a feeling of

> being recognized as a valuable participating and contributing member of a group of peers sharing an inescapable context of mutual collaboration, dialogue, and collaborative knowledge building (CKB)" (Sorensen & Andersen, 2017a p. 57-58)

As this study has focussed strongly on developing technology-based interventions for supporting inclusion, the majority of the investigation is about 'what is'. Which technologies can be used, how they will work, what is actually happening, when teachers are acting consciously in the development processes in the case study behind the dissertation articles.

Though, this retrospective examination of the studies through the lens of the work of Skovsmose and Borba (2004) provides an enhanced awareness on the relevance of considering 'what is not there' (ibid. p. 5). And three things seem actually to be missing:

1. Focus on pedagogical purposes behind utilisation of the technologies
2. Focus on passivation with technologies
3. Focus on learners' technology self-efficacy (McDonald & Siegall, 1992)

From the perspective of today it may be important to scrutinise if, in reality, technologies are being deployed with such fine imagined situations as ideal? Why are schools investing in digital learning platforms, portals and personal gadgets? For what reason are teachers introducing apps and augmented reality in the lessons? What is actually supposed to be supported, when assistive technologies are granted selected learners? A critical reasoning may be of relevance for promoting a conscious employment of digital technologies for learning.

Figure 31 suggest some of the identified purposes for using technology in learning. The presented research paper (Sorensen & Andersen, 2017a) calls for using technologies to empower[9] learners (ibid.), which means that the technologies should increase the learners' autonomy and self-determination – and enable them to represent their own interest in a responsible and self-determined way, where they can act on their own authority (Freire, 1970; Page & Czuba, 1999).

[9] Empowerment can be defined as "*a multi-dimensional social process that helps people gain control over their own lives. It is a process that fosters power (that is, the capacity to implement) in people, for use in their own lives, their communities, and in their society, by acting on issues that they define as important*" (Page & Czuba, 1999).

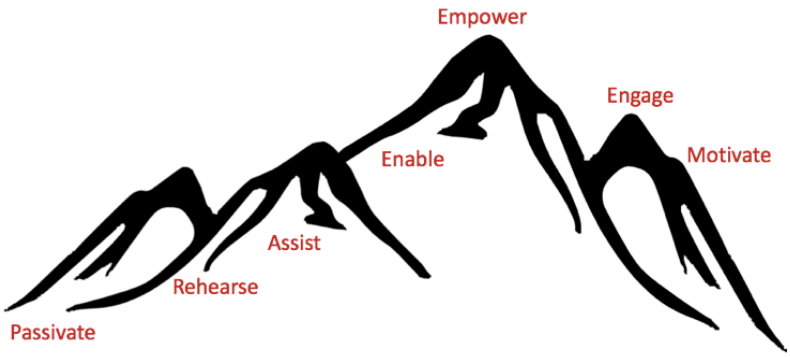


Figure 31 Different purposes for using technologies in learning

But if schools critically evaluate the use of technology in arranged situations, would they then recognise a focus on empowering learners through technologies to become stronger, more confident, and controlling their lives and claiming their rights? Would they observe learning technologies applied for rehearsing specific isolated skills, assisting learning processes or even enabling learning that seems impossible without technology as suggested by Abbott (2007a; 2007b)? Would they see technologies integrated in the classroom as a tool for motivating and engaging learners' participation and behaviour in learning processes as described by Fogg (2003; 2007; 2009)? Or will they notice that deployed technologies to a great extent passivate the learners in the classroom teaching as experienced in some of the classroom observations behind this study? These questions will be left for further consideration, observation and critical reasoning, in order to encourage teachers, school leaders and researchers to go out and do investigations in the real world classroom setting and notice how different it can be.

It is throughout this study demonstrated how technologies hold a great potential for stimulating focus learners' autonomy and impact their self esteem in learning processes (Andersen & Sorensen, 2017a; Andersen & Sorensen, 2017b; Andersen, 2015; Andersen & Sorensen, 2017c; Sorensen & Andersen, 2017a; Andersen et al., 2017). To utilise this potential, it is, though, necessary to be aware of the level of technological self-efficacy (McDonald & Siegall, 1992) by both focus learners and teachers. Technology Self-Efficacy (TSE) can be defined as 'the belief in one's ability to successfully perform a technologically sophisticated new task' (ibid p. 467).

The study of Sorensen & Andersen (2017) experiences the TSE by learners and teachers as being very diverse:

> "In some cases it is observed how learners throughout a school year, methodologically and structured, were taught to use tools such as e.g.

> Google Apps or CDord and were achieving fine results with all their focus learners. In other cases, we observed a more random approach, where it was more incidental if the teacher and learners managed the technologies used. It becomes the responsibility of the focus learner, whether he/she is able to manage the technologies used at school, and in such cases the technologies are used to a smaller degree." (Sorensen & Andersen, 2017a p. 54).

The majority of focus learners in the ididakt project received no further support in developing sufficient TSE to deal with their specific challenges in classroom activities. If they met teachers with high TSE they were supported well in the ordinary classroom activities, but if the teacher had low TSE it was bad luck. Both examples are noticed. Likewise, learners highly supported with hard- and software, but almost 'lost in hyperspace' (Harlin & Brown, 2009) when it came to make use of the equipment.

When selecting technologies and making the purposes visible it may as well be valuable to clarify who in the current situation is in charge for development of sufficient TSE by learners with special needs. Some of the learners (and teachers and parents) may need individual training to cope with the technologies and utilise the equipment provided.

Next step in the framework (figure 32) suggests teachers to be critical and clear about the purposes for implementing a given technology: Will the learners get a voice and opportunity to be heard (and by whom)? Will he be aware of what he knows and how he achieves? Will he be able to return to the content later? Will it help him to experience a feeling of pride? Will he get assistance for whatever is challenging to him? Clarification of such objectives may help teachers to consider which available technologies will serve an imagined situation best possible and design adequate technology-based interventions.

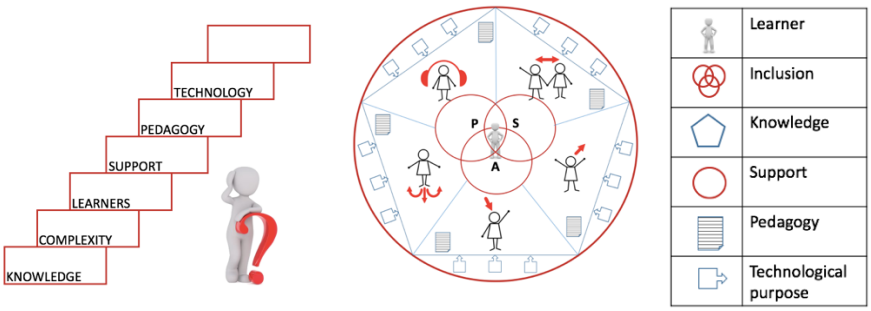
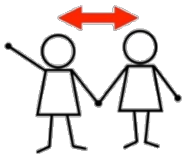


Figure 32 Framework for teacher support step 6: Making the technological purpose visible

6.7. MAKING THE OVERALL GOAL VISIBLE

Solitude or co-existence – or learning-together-apart with digital dialogic technologies for kids with developmental and attention difficulties



”An overall political vision of a prosperous society is one in which everyone has the same access and possibilities of participating in democratic processes, and in which everyone has equal access to the resources, life and learning – a society grasping the potential of diversity. This study reports on research into the impact of digital technological interventions for including kids with attention and developmental difficulties into school class contexts. The paper describes, how the authors have approached the challenge of researching inclusion of kids with attention and developmental deficits for communication, collaboration and knowledge sharing. Some of the questions addressed in the study are: How – and in what sense - may technology and technological interventions be utilised to enhance this approach with our focus learners? In which situations does it occur in the case study? The data analysis assesses the potential of interventions with digital technology for acting as stimulating enzymes for life and learning. On the basis of a thorough discussion of the analysis and findings, the authors assess the degree to which interventions with digital technologies may promote inclusion through stimulating the participation in life and learning of kids with attention and developmental deficits” (Abstract in Sorensen & Andersen, 2017b).

Chapter 3 describes how focus learners often are experienced as challenged when it comes to communication and collaboration with others. Throughout the literature, conflicts are well known when focus learners with e.g. low productivity, lack of procedures, poor ability for organising, insufficient memory, poor persistence and initiation, disturbances, inappropriate behaviour or lower tolerance are working in groups with peers (section 3.2). On the other hand, it is, likewise well known most focus learners are very interested in collaboration with peers (as illustrated in figure 22) and seem to get support for both overviewing, focussing, understanding and communicating during dialoguing and collaborative processes. It, though, appears to be an extensive need for developing pedagogical practices focusing on stimulation of focus learners to co-enact, dialogue and collaborate, which is the theme of investigation in the last dissertation paper (Sorensen & Andersen, 2017b).

The study considers dialogue as vital for learner empowerment and emphasises the

dialogic affordances of technologies as crucial for supporting inclusion and stimulate the individual learner to join the classrooms choir of voices in the polyphonic symphony (e.g. Sorensen, Takle, Taber, & Fils, 2002; Dysthe, 1997). But, it is as well pointed out, how teachers – as key conductors or choirmasters - may implement pedagogical methods to support:

- collaborative knowledge building (CKB) dialogues (Sorensen, 1993)
- learners' contribution in the learning community (Wenger, 2008)
- co-construction of new and true knowledge (Colaizzi, 1978)
- development of learners' initiative, ownership and identity (Kohut, 1990)

The study illustrates how technologies are applied to oblige these demands when learners are dialoguing, networking, producing and sharing learning products on learning platforms and in virtual learning environments as shown in figure 33.

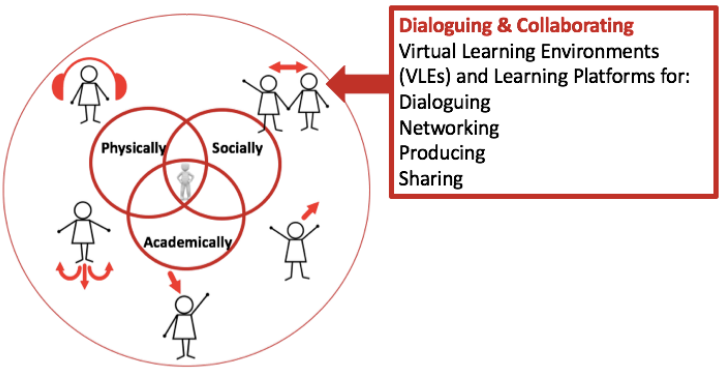


Figure 33 Technology-based interventions for supporting dialogue and collaboration

The dialoguing processes are supported when learners are working together, writing in the same document and collaborating synchronously or asynchronously on the same task, or when they are dialoguing synchronously on Skype on tasks they are solving collaboratively or individually. The networking processes are initiated, when learners are learning from each other's presentations and comments at blogs or webpages and using calendars or groups spaces for their co-work. The learners use a range of digital applications in the production processes as e.g. Word/Docs, Powerpoint/Slides, iMovies, BookCreator, WriteReader or Mindmeister and they share them at different platforms (e.g. Google Drive, Office OneDrive or Showbie).

A profound examination of the use of Google Apps for Education (GAfE) as Virtual Learning Environment (VLE) for dialoguing and collaborating processes is carried out, but the technologies are used in various ways in the different context, why the investigation yields more inspiration than solid evidence for best practice. Some

patters are though identified:

1. Focus learners are working with peers and contributing in tasks solving processes when using applications from GAfE
2. Focus learners articulate pride for the learning products even if their participation or contribution is peripheral
3. Focus learners are navigating through task solving processes by lurking in shared documents
4. A significant discrepancy between teachers' or pupils' technological competences implies a similar discrepancy in the utilisation of the technology as a tool for supporting learning and inclusion
5. Utilisation of the technologies seems to be more dependent on the teachers' rather than the learners' technology skills

The findings illustrate some of the affordances of technology for supporting and including learners – but, as well, some of the limitations:

> "Insecure focus learners find a lot of help and support to participate from using visible structures, commonly created content and from the collaboration with peers. We observe through interviews with focus learners, how they feel pride in relation to their commonly created products – even if we know from the blog statements of their teachers that their participation and contributions were peripheral. On the other hand, we also observe how focus learners may feel so vulnerable and have so little to contribute with that it becomes difficult for them to participate, openly and equally" (Sorensen & Andersen, 2017b p. 8)

'No man is an island entire of itself; every man is a piece of the continent, a part of the main'. These words from the English poet John Donne (1624) remind us to understand focus learners - not as islands in the including school setting – but as parts of the main. From the perspective of today it seems relevant to discuss if technologies actually serve inclusion in any cases and be aware of the limitations of the potential.

Digital technologies for structuring (section 6.3), shielding (section 6.4), differentiating (section 6.5) and producing (section 6.6) have in this study demonstrated to be valuable tools for focus learners' participation and contribution in the basic including classroom. However, these tools may only be understood as stepping stones towards the real overall goal in children's development and learning: to be a part of the main. To be a part of the main in the 21st century education can be understood as being empowered to communicate and collaborate in processes of problem solving and shared knowledge building with peers (Ananiadou & Claro, 2009).

Learners may experience to be a part of the main, when they are working in the same virtual learning environment (VLE), which allows them to learn, dialogue, create, and build knowledge together and easily share tools, documents, or multimodal products. It is, though, observed that this precious potential of technologies will not necessarily be fulfilled in any arranged situation only by implementing a VLE (Sorensen & Andersen, 2017a; 2017b; Andersen et al., 2017). If the overall goal is to empower learners to communicate and collaborate in processes of problem solving and shared knowledge building with peers all stakeholders must commit themselves to a pedagogical practice where the VLE is being employed to support this goal.

Technologies with affordances for collaboration can be used individualised, if the collaboration goal is not prioritised by the teachers in the learning design. Tools intended for supporting inclusion can be used in an excluding manner if pupils are stigmatised with specialised tasks and tools. Virtual Learning Environments to promote dialogue and communication can be applied in heavily individualised and competitive learning designs, where collaborative knowledge building is considered as cheating. The pedagogy serves the goals. The technology serves the pedagogy.

Considering the widespread use of learning platforms and digital learning portals in Danish public schools these years may give rise to further investigation of the extent to which the used technologies promote genuine learning (Rogers & Freiberg, 1994; Colaizzi, 1978) and empowerment (Freire, 1970) of learners. It could be a concern that the powerful learning potential in dialoguing, networking, producing and sharing may disappear if the practical organisation is primarily aimed at individual allocation of learning resources, monitoring of individual progression and compliance of specific curricular goals.

Sorensen & Andersen (2016;2017b) suggests that the potential of a technology for interfering with, innovating and developing new pedagogical practices may be dependent on three interacting factors:

1. The functionality of the technology
2. The pedagogical visions by the teachers, and
3. The context, in which the technology is to be implemented

The functionality of a technology signifies both content, possibilities and how the Human-Computer-Interaction (HCI) (Sharp, Rogers, & Preece, 2007) is experienced by teachers and learners. Critical assessment of the functionality of a given technology may be facilitated by questions such as: What does this technology provide the user? What can the user do with the technology and how is the content presented? How easily can the user navigate and manage the tasks? How much does it take to be familiar with the technology?

The pedagogical vision is similar to the overall goal or imagined situation. Transparency may be established in discussions as such: What is the overall goal for our teaching and schooling? What is the overall goal for the inclusion processes? How do we think of the concept of learning? How can we reach any agreement on these questions – and who determines the answers?

The context, in which the technology is to be implemented is similar to the current situation. The context contains both a perspective of the local learning context in the classroom and the global context in the school and outside school: The learners, teachers, school environment, atmosphere in the classroom, home situation, access to technology, WIFI etc. Some contextual implications will be discussed in chapter 7.

Figure 34 illustrates, how an awareness on the overall goal with education and functionality of accessible technologies is suggested as a final step in the framework as they may both impact the main.

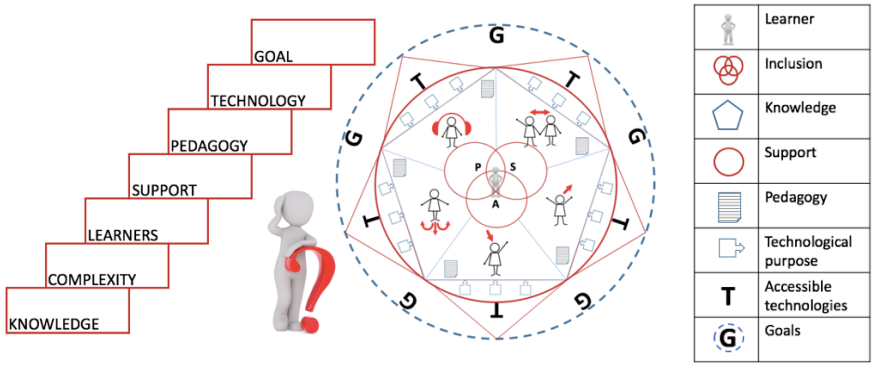


Figure 34 Framework for teacher support step 7: Making the overall goals visible

To assist schools in the challenging processes of moving toward including 1:1 learning designs, a holistic view on both the individual learner, the environment, the task, the technology, and the overall goal seems to be needed. Furthermore, it may be beneficial to consider a Universal Design for Learning (UDL) (Hall et al., 2012) approach. UDL involves the design of products, environments, programmes, or services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design (ibid.), but UDL does not exclude assistive devices for particular groups of persons with disabilities where these are needed.

CHAPTER 7. DISCUSSION

Chapter 6 reflects on past research and argues for a conceptual model (figure 35) for supporting teachers in development of innovative pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties. The model contains two perspectives: Support of learners and support of teachers.

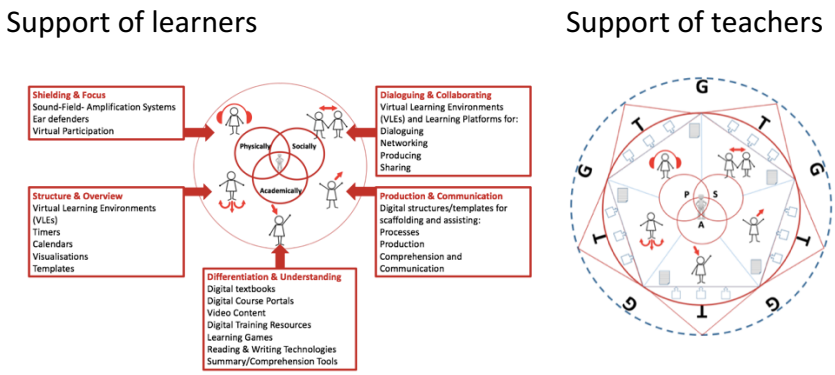


Figure 35 Conceptual model for supporting teachers in development of an including technology-based practice

Throughout this study a range of contextual challenges are brought to light, which may hamper the teachers' chances for realising the vision of developing innovative pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties: A lack of technologies at hand, a lack of teachers' competences, the infinite stream of new technologies and a lack of collaboration among stakeholders are mentioned as important gatekeepers (Andersen & Jensen, 2018). Some of them will briefly be discussed in this final chapter.

Visible versus invisible disabilities

Bolic et al. (2013) describes that it is easier for learners with visible physical disabilities to get access to support than it is for learners with invisible psychological disabilities (as e.g. access to technology). Similar findings are exposed in the ididakt project, where a physical disabled learner was supported by an educated pedagogue while a group of learners with developmental and attention difficulties were supported by random labourers without pedagogical training or not supported at all. From the perspective of the needs for professional pedagogical support, it can be discussed why these roles were not turned. Section 6.3 has argued for making the learners' needs and challenges visible to enable adequate support. The research of

Tymms & Merrell (2006) concluded however that exposing students special needs without providing teachers any pedagogical support worsened the conditions for the learners.

Technology versus practice

Much of the research available in this field is about test of emerging technologies, and findings related more to development of technologies than pedagogical practices (Andersen & Jensen, 2018). Even if a technology in itself seems promising for a certain purpose, it may fail when it has to be implemented in a school context. The research from ididakt exposes e.g. Skype as a beneficial tool for mediating focus learners' presence and participation in situations, where they are unable to attend the classroom setting. The learners are quite familiar with the technology from everyday life, why it should be an easy technology to implement in the classroom, but it was not. The teachers found it difficult as it conflicted with other issues in their practice as e.g. rules for compulsory attendance, supervision etc.

1:1 versus 1:28

The majority of studies available is conducted in laboratory, treatment, or special school settings (ibid.), where technologies or interventions are examined in different conditions than those in a basic classroom. These studies are designed as a 1:1 situation, where a teacher or a therapist is working with only one learner – or one learner is working in an isolated setting with a technology. Such conditions are quite unusual in the basic classroom, where, generally, one teacher is alone with up to 28 pupils. This challenge became e.g. evident in classroom observations when using a structuring tool. The technology is regarded as a valuable tool for learners with developmental and attention difficulties in SEN education, where primary contacts are scheduling the day individually for each learner. Teachers in basic education did not have time for such individual scheduling. Consequently, the focus learners were left to manage their own devices. Otherwise, the schedule was constructed very generally to fit all learners, which implied that the focus learners did not receive necessary support (Sorensen & Andersen, 2016).

Standardisation versus diversity

A similar dilemma is recognised between the aims at standardisation and diversity. An including classroom is expected to meet all children's different needs, the pupils are, on the other hand, expected to march in time: They are classified by age, and will be tested concurrently at equal academical level. They are mostly doing identical tasks and working with the same topics. In the study of ididakt this problem is exposed in secondary classes, where focus learners are striving hard to learn math. They find it difficult to handle tasks with much information and simultaneously use different algorithms and strategies. They are not at the same academic level as the

peers, but work with content from 5th or 6th grade. They are struggling with the tasks, and the teachers are encouraging and praising their efforts and achievements. However, when they receive their marks they are assessed after the curriculum for 8th grade and lose all faith to the teachers' appreciation of their progression (Andersen & Sorensen, 2017c). In truly to succeed in including all learners, it might be beneficial to leave the standardisation and instead adopt a 'stage not age' (Heppell, 2017) or Universal Design for Learning (Edyburn, 2005; Hall et al., 2012) agenda, where diversity is expected and accepted. It might solve some of the challenges teachers and learners are experiencing in the traditional educational system, why further research seems to be interesting and relevant. Regretfully, the educational system in Denmark does not seem to be ready to follow this line for the moment.

Individual versus collaborative task

DuPaul (2012) suggests a participatory approach, where both learners, teachers and families are considered as valuable stakeholders. The fieldwork of ididakt, on the other hand, exposes a tremendous lack of collaboration on schools. Teacher are either struggling individually supporting focus learners - or they are left alone as a team with no assistance from experts. The first example entails that focus learners only receive support in a part of the lessons. The second example shows the random support being dependent on if the learner will meet teachers with adequate knowledge and skills to support his needs. Such 'stand alone' approaches constitute a risk of creating feeling such as insufficiency, frustration, and stress by the teachers and hampers a cohesive endeavour for the focus learners' benefit.

Uneducated vs. skilled

The majority of studies emphasizes teachers' pedagogical and technological competences as the most important gatekeeper (Andersen & Jensen, 2018) as e.g. described by Tan and Cheungs (2008):

> "Teachers play a vital role. They need to be very organised, have expert skills, have routines well established and be adaptable to ever-changing factors and conditions in the mainstream classroom" (ibid.).

As earlier mentioned, the rapid development and infinite stream of technologies make it difficult for teachers to choose among thousands of possible tools and have appropriate technological competencies to work with them (Jeffs et al., 2006). Likewise the fieldwork of ididakt shows that a large part of the teachers are calling for inspiration, support and training in how to use technologies in an including approach (e.g. Andersen et al., 2017 p. 142-148; Andersen & Sorensen 2016; Sorensen & Andersen, 2016).

Adjustment vs development

DuPaul et al. (2011) noticed a significant difference in research literature: The amount of research available concerning methods to remediate academic problems associated with ADHD is small, compared to studies regarding ways to treat behavioural and social difficulties with the disorder. In contrast, it may be considered as remarkable that professional treatment of behavioural and social difficulties is almost non-existing in the Danish including school context and supposed to be facilitated by the teachers simultaneously with their classroom teaching. It may be relevant to initiate new investigation of such supplementing strategies in the including school setting based on findings from existing research.

The study of Zafiropoulou & Karmba-Schina (2005) indicates e.g. positive results on cognitive skills, learning strategies, academic self-confidence and engagement by providing individual, weekly psycho-education, self-instruction training and attention control training carried out by a psychologist for 2^{nd}-4^{th} graders. Similar interventions were in a Danish context earlier conducted at SEN schools by SEN teachers or SEN pedagogues supervised by psychologists aiming at developing self-understanding and a learner's awareness of his own learning processes. During two years of investigation such psycho-educational interventions are not observed by the 56 focus learners. Rather, it seems that efforts are made in the course of 'adjustments' of the focus learners to fit the school setting. It may be interesting to investigate the impact of such psycho-educational interventions in a Danish including school context.

Likewise, it may also be relevant for further development and research processes to carry out more experiments with interventions placed in the 'grey area' between teaching and treatment as e.g. social stories, and integrate students' own production of social stories as a part of their academic tasks. Social stories have been used successfully to improve social skills (Bledsoe, Smith, & Simpson, 2003), following directions (Brownell, 2002), sharing (Kuoch & Mirenda, 2003), requesting attention and reduce inappropriate behaviours (as e.g. chair tipping, shouting, staring, refusal and tantrums) (Thiemann & Goldstein, 2001). Delano (2007) demonstrates similar positive findings in his study on Video-modelling Social Stories produced to support learners' classroom and on-task behaviour. Video-modelling has also been used successfully in the ididakt study, but only related to the curricular content (in a Flipped Learning approach), why the potential for supporting behaviour and social difficulties has not been examined yet.

Time vs tasks

Finally, it is necessary to mention one of the most important constraint for utilising findings from research and develop teacher practice recognised from this study: Lack of time.

> '… what teachers seem to miss the most, when dealing with developing a new pedagogy-based including approach for their professional activities, is the parameter of time. Time to learn how to do it. Time to discuss interventions with colleagues. And time to modify and differentiate their courses to many different needs. Time to get experience and become Experts instead of Novices (Andersen & Sorensen, 2016 p. 9).

It can be considered as trivial to spend time on discussions of the parameter of time as it can be understood as an inevitable disturbing factor in 21st century human life. For that reason, it is avoided to highlight this issue throughout the reflections in chapter 6. However, it will be an issue at every stage in the suggested framework for teacher support why it cannot be ignored: Time to acquire new pedagogical and technological knowledge, time to identify the learners and their special needs, time to be familiar with technologies, time to receive and implement advice from expert support, time to discuss, negotiate, choose, evaluate and reiterate interventions with colleagues etc. The parameter of time can be understood as a shadow which may impact this entire piece of research. Figure 36 attempts to summarise this discussion and to show how schools and teachers may be aware of contextual challenges and dilemmas which may hamper their efforts related to developing an including technology-based practice.

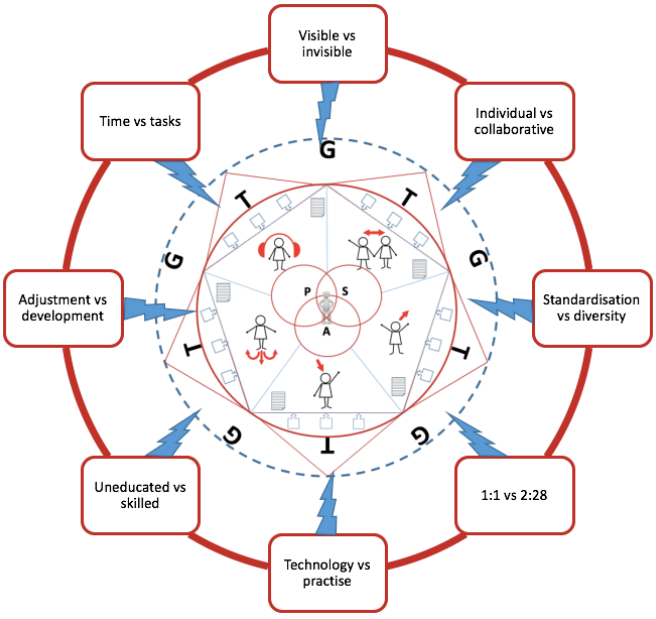


Figure 36 Identified contextual challenges and dilemmas

CHAPTER 8. CONCLUSION

This study examined how teachers can be supported to develop innovative pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties. An investigation was carried out at 11 schools, where teachers and researchers collaborated in participatory research processes on development of new including pedagogical approaches supported by technology.

The study was framed by an overall political vision of establishment of an including educational system, where learners with special educational needs visit local basic schools and are taught in classes with peers of the same age. Danish schools were caught in a situation, where teachers were struggling to solve this new task and expressed a lacking pedagogical imagination regarding possible solutions. The research investigated how this current situation was experienced from the perspective of 46 teachers and 56 learners with developmental and attention difficulties (focus learners) and exposed a complex situation, where various agendas seemed to influence the possibilities for invention of new pedagogical practices.

The scene of the situation was directed by teachers, who felt it difficult to meet their own professional expectations regarding inclusion of focus learners with developmental and attention deficit. They recorded lacking support from Pedagogical Experts (PPR) and wanted knowledge on efficient pedagogical tools regarding focus learners as they did not experience themselves as having adequate knowledge and skills to deal with this new challenge. They seemed to be very concerned about the welfare and achievements by the focus learners, and dedicated for development of alternative practical organisation, but experienced the fixed boundaries in the school system and a small amount of resources, staffing, skills and time as constraining factors. They demonstrated plain speaking about focus learners' interruptions, anger, lacking motivation and disturbances in the classroom and expressed a concern about the impact of this behaviour regarding their own teaching, the welfare and learning by peers – but mainly the inadequate conditions of focus learners were provided in the school. Finally, they asked for a shared overall inclusion pedagogy (Andersen et al., 2017 p. 64-67).

The main actors in this scene – learners with developmental and attention difficulties – covered learners who were challenged in one or more of the following conditions: memory, attention, organisation, initiation, persistence, hyperactivity, impulsivity, behaviour, emotions, pro-social behaviour, having friends, understanding and conceptions, language and communication or rigidity. Some of them diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) or Autism Spectrum Disorder (ASD), but the challenges were also appearing without these diagnoses. When this group of learners acted in the scene of the basic school environment, they often fell short in

the academic work, the social community or the physical presence. Some of them were thriving badly in the including school, why parents and teachers were sharing concerns. Behind this scene, school leaders seemed to be aware of the situation but pressed by economic, political, and administrative agendas. Observations in the field uncovered extensive variation from school to school, classroom to classroom, teacher to teacher and learner to learner.

Experiments was carried out in this current situation in order to examine the extent to which technologies would work as tools for supporting learners with developmental and attention difficulties, when teachers were designing and implementing new including pedagogical interventions in their classroom teaching. From the perspective of many learning situations in 26 classes, where all student had used various technologies, teachers and researcher identified five categories of technology-based intervention as potentially powerful for supporting the 56 focus learners (Andersen & Sorensen, 2017a), and subsequent research supported these findings (Andersen, 2015; Andersen & Sorensen 2017b; 2017c; Sorensen & Andersen, 2017a; 2017b):

1. Structure & Overview
2. Shielding & Focus
3. Differentiation & Comprehension
4. Production & Communication
5. Dialogue & Collaboration

Andersen & Sorensen (2017b) described how focus learners' experiences of empowerment and self-efficacy were enabled, when the daily program and tasks were structured in ways, which allowed the learners to overview what they had to do and what they were supposed to learn. The study included technologies as Virtual Learning Environments (VLEs), Timers, Calendars, Visualisations and Templates used to support focus learners' attention, **structure and overview**. The findings exposed how such technologies had supported focus learners in understanding, enabled self-monitoring in task solving processes, and enhanced experiences of flow and success. Supplementing studies (Andersen & Sorensen, 2016; Sorensen & Andersen, 2016) emphasised, though, that it was difficult for teachers to find time for planning and accomplishing individualised solutions because of limited time for preparation. Feasible solutions seemed to necessitate one-size-fits-all approaches, which, on the other hand, would be insufficient to support learners with special educational needs.

Andersen (2015) presented how technologies for **shielding and focus** as e.g. ear defenders, headset with music, Sound Field Amplification Systems (SFASs) and virtual participation had worked as interventions to support presence and participation in the classroom. The findings exposed e.g. how SFASs had supported focus learners to:

- Become calm, quiet and focussed in the classroom
- Become attended and participate in class teaching
- Be able to hear and understand the teacher's instructions
- Be able to work concentrated during individual school work

At first, it was expected that such positive results were subsequently implemented in the classroom teaching, but they were not. Fear of exposing vulnerable learners, price on equipment, lacking technological support and lacking agreement by teachers were recognised as explanation for this surprising finding.

Andersen & Sorensen (2017c) suggested digital books, digital course portals, video content, digital training recourses, learning games, reading and writing technologies and summary/comprehension tools as valuable for differentiating the teaching and assisting focus learners when working with content matter. These technologies had during the study due to the various modalities and learning approaches in various ways facilitated **differentiation and comprehension** by the focus learners. It was noticed, though, that these including technologies were not used in a consistent practice by all teachers. Unskilled and technology-insecure teachers showed some resistance, but lacking access to technologies also seemed to influence the extent to which the beneficial potential was utilised.

Sorensen & Andersen (2017a) illustrated, how technologies were applied for scaffolding and assisting processes of **production and communication**. Numerous examples from the study had shown, how technologies had enabled focus learners to reify their knowledge, master their processes and experience ownership, independence and autonomy in task solving processes. Reification and dissemination enabled focus learners to bring themselves and their knowledge into play and thereby obtain an opportunity to reflect upon their own participation and contribution. Digital resources made the processes of production easier and less risky, enabled possibilities for genuine learning, where focus learners worked independently and experienced success in both individual and collaborative task solving processes. Consequently, it was argued that such technology-based interventions provided focus learners experiences of being included, academically and socially, in the learning environment.

It was also exhibited how technology-based interventions had supported focus learners to participate in **dialogue and collaboration** and contribute in collaborative knowledge building (CKB) processes using e.g. shared portfolios, shared documents and writing processes, file sharing, chats, skype etc. (Sorensen & Andersen, 2017b). It still seemed to be difficult for all teachers to implement these possibilities in their teaching practice. The study rejected that teachers' pedagogical and especially technological skills seemed to be crucial for utilising the including potential of technologies.

Even though the dissertation articles presented mixed results, the findings demonstrated ample patterns, which merged together enabled construction of a comprehensive model for 'including technology-based interventions' (ITI5) for learners with developmental and attention difficulties as illustrated in figure 37. The study suggested this model as inspiration for teachers' pedagogical imagination of what might be initiated - and as a toolbox for their practical organisation of including teaching practice.

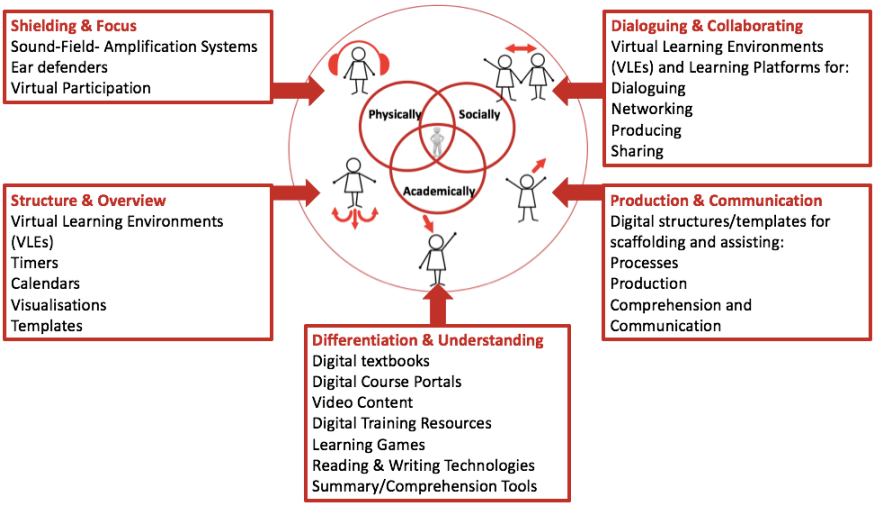


Figure 37 Five categories of including technology-based interventions (ITI5)

Comparing the findings illustrated in figure 37 with the challenges and recommendations for learners with developmental and attention difficulties (table 11), technologies in different ways had demonstrated to be valuable for supporting memory, attention, organisation, initiation, persistence, behaviour, and understanding and conception of language and communication, while hyperactivity was decreasing. It seemed evident that the technologies could be used to increase predictability and routine, enable teachers to provide specialised curriculum and establish a supportive teaching environment through conscious design of technology-based interventions.

On the other hand, the study did not demonstrate significant improvement regarding impulsivity, emotions, pro-social behaviour or supported focus learners in having friends. These challenges might need other kinds of pedagogical or treatment support. Use of technologies for transition support and family involvement was not in focus in this current study, but could be suggested for further research.

Areas of challenges for learners with developmental and attention difficulties (from table 4)		Recommendation for learners with developmental and attention difficulties (from table 3)
Memory	Emotions	High predictability and routine
Attention	Pro-social behaviour	Specialised curriculum
Organisation	Having friends	Supportive teaching environment
Initiation	Understanding and conception	Functional approach to challenging behaviour
Persistence	Language and communication	Transition support
Hyperactivity	Rigidity	Family involvement
Impulsivity		
Behaviour		

Table 11 Challenges and recommendations regarding learners with developmental and attention difficulties

However, the study also discovered that the five categories of including technology-based interventions in the ITI5 model did not work in an everyday context of investigation. Consequently, a reflection from the perspective of today looked 'through' the studies in order to identify, discuss, and describe necessities, constraints and challenges when teachers employ such interventions.

Teachers in the study were broadly calling for inspiration to alternative pedagogical approaches, and to a high extent exhibit lacking pedagogic imagination and skills regarding special educational pedagogy and technology (Andersen & Sorensen, 2016). Thus, first of all it was recommended to **make the knowledge visible** and enable teachers to learn about the general affordances and potentials of technologies for supporting special educational teaching and learning. If teachers were provided access to insights from research, as e.g. those identified in the ITI5-model (figure 37), or in the review by Andersen & Jensen (2018), such findings could be utilised as enzyme for their pedagogical imagination and practical organisation, and in that sense as inspiration for development of alternative including technology-based pedagogical approaches. But it was not considered in terms of access to knowledge or technology.

It spoke for itself that the inclusion was an ongoing complex concept to deal with. Challenges for both teachers' and learners' involved in the inclusion process were described and discussed in the primer result from the study (Andersen & Sorensen, 2017a), and later critical reflection sustained this situation. Schools were caught in a tension field between ethical visions, political demands, economic constraints, and pedagogical challenges. It was, furthermore, emphasised that no pedagogical model or outstanding technology in itself left clear answers or quick fixes to solve the complex task of inclusion. Consequently, it was suggested schools to **make the complexity visible** as it could indicate for the teachers that full inclusion was neither possible nor expected them to realise. Rather, the goal for the teachers might be described as establishing a more including learning environment. Establishment of a shared language for interpretation of the concept of inclusion combined with

consciousness and openness about when and how to include and exclude learners seemed to be crucial tools for supporting teachers in this complex challenge.

The study described how most focus learners had difficulties performing at the same level as their peers, and mostly exhibited a schoolwork characterised by low productivity, many errors due to carelessness or inattention and poor organisational ability (Andersen & Sorensen, 2017b). The teachers were to a certain extent aware of this situation, but shared and conscious strategies for how to intervene were infrequently demonstrated. The retrospective walk through the dissertation articles emphasised the value of **making the learners visible** and critically investigate their differences, challenges, strength, and possibilities in the school setting in order to create a better understanding of their needs. Such illumination had in the participatory action research processes shown to support development of a shared language, facilitated collaborative problem-solving processes and established shared backing for alternative pedagogical interventions among teachers. Based on these experiences and the idea that nobody had access to unquestionable knowledge, collaboration with colleagues, learners and parents was argued for as relevant in processes of:

- Defining current situation
- Discussing new imagined situations
- Implementing alternative practical organisation
- Evaluating arranged situations
- Redefining through critical reasoning

Unfortunately, Andersen (2015) discovered how teachers lost focus on the positive experiences from the research interventions and stopped using them when research was finished. Subsequently, critical reflection advocated for **making the support visible**, as the full study demonstrated a consistent lack of support when it came to understanding and managing the focus learners' needs pedagogically and the tools technologically (Andersen & Sorensen, 2016; Andersen et al., 2017). Postgraduate courses regarding inclusion, special education and technology were suggested as a part of the teacher support, but supervision provided closely related to the teaching practices in the classroom was maybe of more importance. Not only as a guidance for teachers when implementing new interventions, but even more critical as supervision during regular adjustment of interventions. Consequently, it was proposed to gather necessary stakeholders and experts around the teachers (as e.g. Pedagogical Psychological Advisory Team (PPR), SEN teams, technology advisers or school leaders) and clarify how they would support including initiatives economically, pedagogically, and technologically.

Reflections on the full study from the perspectives of today left a clear message that identified changes did not occur because of the technology, but because of the

pedagogy with technology (Andersen et al, 2017). When comparing the actual arranged situations in the classroom with the desired imagined situation it was apparent how different pedagogical strategies were crucial to harnessing the technologies and increasing focus learners' ability, motivation or both. Andersen & Sorensen (2017c) stated that numerous examples of successful interaction of technology and pedagogy have been found throughout the study. Unfortunately, not as a consistent practice but more random and dependent of individual teachers' practices. Consequently, it was suggested teachers collaboratively made **the pedagogy visible**, which means be conscious about their pedagogical choices and willing to argue for them. It encompassed critical reasoning about pros and cons with teacher colleagues, dialogue with parents and school leaders in order to promote shared goal and shared responsibility for the development processes with all stakeholders.

Sorensen & Andersen (2017a) illustrated with various examples the value of technologies for learners' production and communication. Digital templates, shared documents, learning management systems enabled scaffolding of learning processes, while multimodal applications extended the possibilities for production, communication and reifying the learning outcome assisted by technologies to compensate for reading and writing difficulties. The study emphasised as well how important it was for teachers to master the technologies in order to help the learners, but more important to be able to exploit the affordances of technologies in their pedagogical practice (ibid. p. 57). Accordingly, the reflection from the perspective of today argued for **making the purpose of technology visible** in order to increase teachers' awareness on the role and function of an applied technology in a given arranged situation. To support this process, it was recommended teachers to consider the extent to which a technology in the real world setting acted as a tool for passivation, training, assisting, enabling, motivating, engaging or empowering the learners.

Even if digital technologies for structuring, shielding, differentiating, and producing had demonstrated to be valuable tools for focus learners' participation and contribution in the basic including classroom, it was argued only to consider these tools as stepping stones towards the overall goal for children's development and learning: to be a part of the main. From the perspective of the 21st century's society, to be a part of the main can be understood as being empowered to communicate and collaborate in processes of problem solving and shared knowledge building with peers (Ananiadou & Claro, 2009). Sorensen & Andersen (2017b) indicated that 'the functionality of the technology at hand, the overall pedagogical vision and the wider organisational context must be understood as a holistic phenomenon' (ibid. p. 6). Following reflections illustrated that such holistic understanding was not necessarily present and technologies could easily be used contrary to the overall goal for education and learning. As a result, **making the overall goal visible** was mentioned as a piece of final advice.

The revisited walk through the dissertation articles from the perspective of today generates a potential seven-step framework (figure 38) for supporting teachers in development of technology-based practices (SUP7), which suggested a visualisation of actual conditions and shared decisions regarding knowledge in the organisation, complexity of inclusion, learners' challenges, available support, agreed pedagogy, workable technologies and substantial goals.

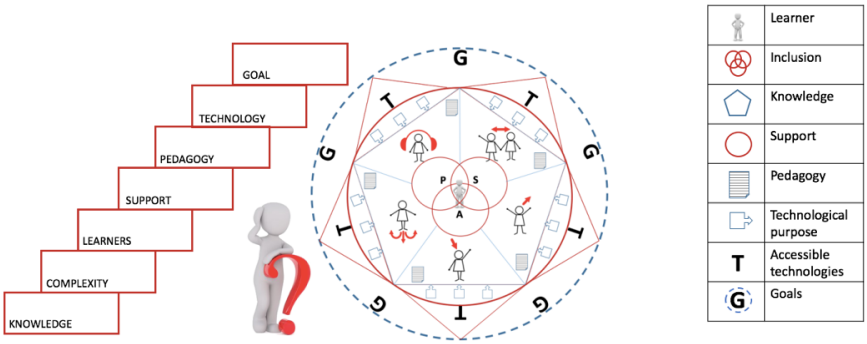


Figure 38 Framework for supporting teachers in development of technology-based practices

Additionally, a range of challenges and conflicting interest from the context, in which the including technology-based approach was implemented, were identified (figure 39). Without a concurrent focus of these constraints, it could be impossible to achieve the desired improvements.

The vision of including all learners seemed e.g. to be hampered by a strong tradition for building learning environments based on age and address instead of stage and interest, where focus learners were too often experienced as left behind. It would be valuable to investigate the impact of a more including approach when constituting learning communities.

Even if the profusion of digital content and tools had made it much easier to support diversity, an increasing demand for standardisation was characterising the basic school system. It could be relevant to deliberate, if such one-size-fits-all-solutions afford the best opportunities for the individual and the expected outcome for the society.

It seemed difficult for teachers to get access to appropriate support for learners with invisible disabilities, why e.g. methods for adjustment of behaviour were utilised to a greater extent in school settings than crucial developmental treatment. It would

be interesting to scrutinise the long time perspectives for this prioritisation compared to research on focus learners' future lives.

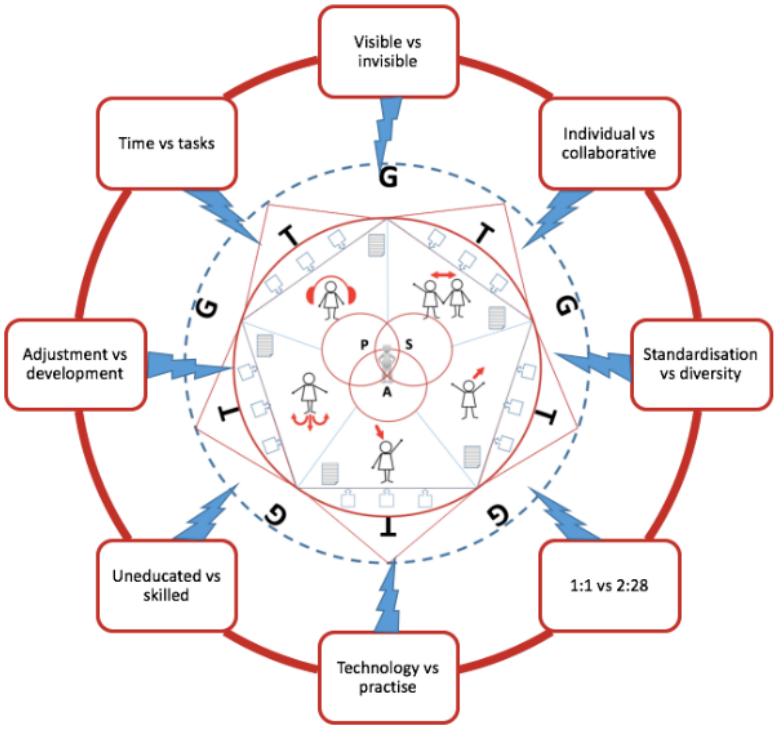


Figure 39 Identified challenges and conflicting interest in the context

With reference to an increasing focus on visible learning (Hattie, 2012), common simplified objectives (Undervisningsministeriet, 2015), and learning output (Mainz, 2016) it was argued that the basic school system seemed to be more aware of learning than learners. It would be of importance, if this study contributed to another main focus for designing education.

Many teachers did to a high extent experience themselves as lacking both pedagogical and technological skills (Andersen & Sorensen, 2016; Sorensen & Andersen, 2016). Combined with the fact that in many cases they were working more individually than collaboratively, would maybe inhibit them in finding the strength to utilising the technological potential for supporting inclusion and learning and transforming their educational practice. It would be fair to conclude that teachers in a 21st century education system needs ongoing possibilities for further education.

Finally, the parameter of time was described as the most important constraint for utilising findings from research and develop teacher practice. Time to acquire new

pedagogical and technological knowledge, time to identify the learners and their special needs, time to be familiar with technologies, time to receive and implement advice from expert support, time to discuss, negotiate, choose, evaluate and reiterate interventions with colleagues etc. It seems inescapable to respond to the matter of time regarding the possibilities for improving both children's learning and teachers' professional working conditions.

Concluding, in order to support teachers' development of innovative pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties, the study finally suggest to utilise the five categories of technology-based including interventions for learners with developmental and attention difficulties (ITI5) (figure 37) in combination with the framework for supporting teachers to develop technology-based practices (SUP7) (figure 38) as a potential answer to the research question as illustrated in figure 40.

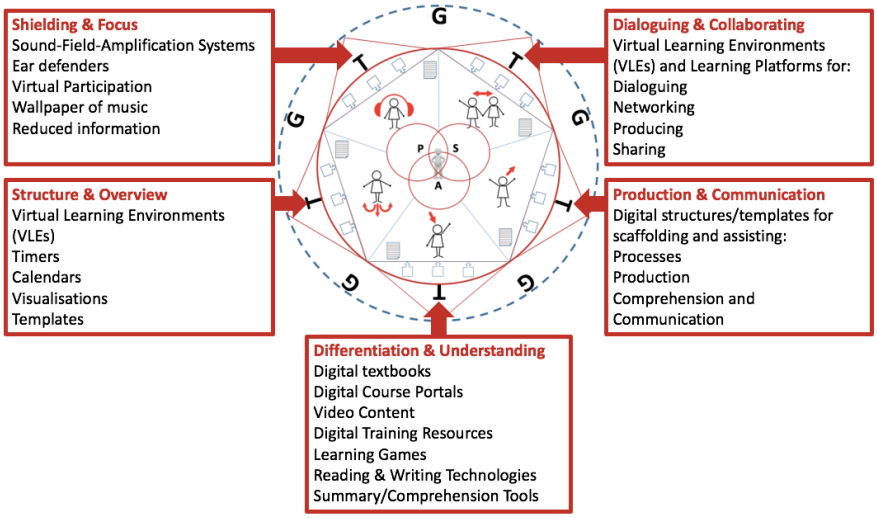


Figure 40 Final comprehensive framework for supporting teachers in development of pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties

CHAPTER 9. PERSPECTIVES

Findings from this study have exposed great value of implementing technologies as supporting tools for development of innovative including teaching approaches for learners with developmental and attention difficulties. Simultaneously, the research demonstrated that such a potential for the use of technologies is not easy to reach. This final chapter discusses some prospective initiatives which may be of importance to consider for further improvements in the field of investigation.

The Salamanca Declaration (UNESCO, 1994) states that every child has a *fundamental right to education*, and must be given the opportunity to *achieve and maintain an acceptable level of learning.* It may be discussed whether the Danish school system lives up to this expectation, when observing the opportunities given the target group of learners in this study. 'Given the opportunity' could possibly encompass necessary treatment to be able to possibly, attend and achieve in education, as these children are not only challenged academically. Most of them exhibit serious social deficits (e.g. Docking, Munro, Cordier, & Ellis, 2013) and social isolation seems to increase with age. Schools may benefit from a more comprehensive approach to social relationship interventions. Research has demonstrated that early interventions targeted behavioural, emotional and neurocognitive functions seem e.g. to foster development of self-regulation (Healey and Halperin, 2015), and such interventions have shown improvements regarding memory, hyperactivity, and aggression as well (ibid.). Five themes of interventions are identified as effective across the literature (section 3.2.4). This current piece of research is investigating two of them: *Academic interventions* and *collaborative consultation interventions*. Future research may be suggested focusing simultaneously on *behavioural interventions*, *self-regulation interventions* and *home-school communication interventions*.

The Salamanca Declaration (UNESCO, 1994) states as well that every child has *unique characteristics, interest, abilities and learning needs*, and that the education systems should be designed and educational programmes implemented to *take into account the wide diversity of these characteristics and needs.* From the perspective of this study, it could be claimed that the Danish school system is not designed to take this diversity into account. As a thumb rule, it is said that learners with developmental and attention deficit are often 1/3 behind their peers of the same age, but in the educational system they are expected to follow the same schedule, courses, and curriculum. Future research could be conducted concerning design of schools and learning communities following stage and interest, rather than age and addresses.

It is widely acknowledged that the 21st century society is characterised by a high complexity and an incomprehensible rapid change. The size of e.g. the central processing unit (CPU) in a computer or the effect of a battery is growing

exponentially year by year and with it the possibilities for new developments. The Internet has provided an enormous access to the world directly from the living room or the classroom. These insights into a globalised world with increasing and almost insoluble challenges have left teachers and schools in a brand new situation, where it seems impossible for them to conduct relevant and up-to-date teaching based on what was learned through four years' enrolling in a teacher education program. Never before have ongoing, life-long, further education been so important. From this perspective, it seems devastating for the education of future citizens that there is almost no time left for teachers' development of knowledge and skills required for teaching in a 21st century digital age (Andersen & Sorensen, 2016; Sorensen & Andersen, 2016). It could be attractive to carry out experiments with new working conditions for both students and teachers, where the weekly schedule e.g. was based on three days with teaching, one day for preparation of good teaching and one day for necessary further education of someone's own choice. Such initiative would possible increase education of teachers 'into practice' – instead of the current situation, where most teachers in further education programs (e.g. Diploma or Master programs) are educating themselves 'out of the teaching practice' and into alternative positions.

The current study exposed not only extensive variations regarding knowledge and skills, but also differences in access to well-functioning technology. It is easy to count the numbers of interactive whiteboards, computers or tablets and register the amount of digital learning resources available in schools. But to investigate how well they are functioning in the teaching practice is more demanding. For many municipalities, it has been a goal to provide 1:1 computing – or request students to 'bring your own device' (BOYD) – and ensure 365/24/7 access to learning resources. Enormous amounts of money is being spent in an expectation to these investments for enhancing and future-proof the education provided. It may be relevant to examine and discuss, if we might have had too high expectations to the potential of technology itself, or if another implementation strategy would increase the results. Would 1:1 investment in technology and teacher education maybe foster more sustainable investments? Would 1:2 technology implementation in the classroom maybe improve the dialogue and the collaboration among students? Awareness on when to digitalise teaching and when not to would maybe promote a dialogue about pedagogy and goals for teaching and learning.

The introduction of the Internet and the web 1.0 and 2.0 waves fostered a great enthusiasm and optimism among teachers and educational researchers – both when it comes to development of new opportunities for learning and for democratising information and communication in the society (Dohn & Hansen, 2016). Email, skype, mobile phones, wikis, blogs and YouTube channels were introduced as extended environments for learning. iPads, apps and a variety of multimodal production tools were used to design different learning environments adjusted to different needs and learners. Nowadays it seems this explorative and immature use of technologies for

learning has been replaced by an increasing demand for more mature focus on learning portals, data security, control and surveillance of learning processes and products. From one perspective these initiatives could provide challenged learners access to a more consistent structure and easier navigation in learning resources. From another perspective, it may exactly be the consistency and boundaries that end up demotivating learners and inhibit individual solutions and adjustments. It seems important to discuss if we are actually limiting the potential of technologies during the quest for consistency and control. Children are not learning by navigation and control. They are learning when engaging themselves in the subject matter and exploring it through curiosity, experiments, and reflections. If academic content is presented, conformingly and un-inspiringly, as daily chunks of links to documents, questions and quizzes, we may have lost the great opportunity for facilitating genuine learning in our pursuit of management. The present intense digitalisation of the Danish educational system with a demand for implementing learning and collaboration technologies prior to introduction of a new content management system (AULA) for all children age 0-16 seems to necessitate an investigation on whether these initiatives in the current version and utilisation are actually supporting or constraining learner engagement.

Finally, it may be of importance for future educational research to build bridges between researchers and practitioners, and to a higher extent facilitate applied research on 'what is needed' in schools from the perspective of learners, teachers and leaders, instead of 'what is effective' from the perspective of the civil service and politicians. Based on the idea that nobody has access to unquestionable knowledge and inspired by the dynamics in mode two knowledge production (Gibbons, 1994), arguments could be raised for development of future methods for initiating, conducting and disseminating research in an applied approach focusing on equality and mutual dependency throughout the life-cycle of investigation. Such inclusive approach could as well be considered, as suggested in section 5.2.3, through a mixed methods way of thinking, where multiple different research paradigms and methodological traditions are invited to engage in a dialogue driven by tolerance, understanding, and acceptance.

Even if the initiation of this study was based on a request from the Ministry of Education for 'knowledge on what works', steps have been taking to 'walk-the-talk' when it comes to conducting research with the participants and disseminating findings from the research to the field of practice. Narratives constructed though the analysis processes are presented at a webpage as inspiration for pedagogical practitioners, working with inclusion challenges, regarding learners with developmental and attention difficulties (www.ididakt.dk). Later, insights from the research articles are adapted into a 'knowledge package' on ICT-supported inclusion which primo 2018 will be launched at EMU.dk. It would prospectively be interesting to watch out for the impact of such initiatives in order to improve the collaboration, develop new – and for the educational practice relevant – knowledge, and generate

a shared language among researchers and teachers in the field of educational research. So saying, these final words may also act as a call to research, for developing a more inclusive approach for dissemination of knowledge with contemporary means of communication, inside and outside the research environment, appropriate for a 21st century digitalised society.

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SUMMARY

This thesis investigates how teachers can be supported in developing innovative, pedagogic designs in contexts of including technology-based interventions for learners with developmental and attention difficulties. The Ph.D. thesis consists of seven research papers, which are gathered in the separate publication: Expanding Scenarios for Visible Learners – the research behind. The dissertation framework falls into two parts. The first part contains the theoretical and methodological basis behind the accomplished research. Second part presents and reflects the articles separately, and combines conclusions from those into a model for utilising technologies to promote inclusion of this target group of learners. While the research articles primarily address teachers and provide them with inspiration for what they may do to support learners with developmental and attention difficulties, the meta reflection to a greater extent applies gatekeepers around teachers as e.g. principals, supervisors, consultants, public servants, or politicians and supply them with a seven-step framework on how teachers may be supported to develop and utilise the beneficial findings from the study. From a context of a nature, in which an including technology-based approach may be implemented, the study identifies as well some challenges and conflicting interest.

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